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MAY, 1845.

CIVIL ENGINEERING.

The Falling of a Mill at Oldham, having cast-iron girders, and brick arched floors.

The inquest on the bodies of the twenty persons (12 males and 8 females,) killed by the fall of the mill of Messrs. Samuel Radcliffe & Sons, at Lower House, Oldham, on Thursday, October 31,—which was commenced before Mr. John Molesworth, (deputy coroner for Mr. Dearden,) and a respectable jury, at the Black Swan, Greenacres Moor, on Saturday, November 2, and continued by adjournment on Monday, November 4,—was again resumed and concluded on Wednesday, November 6; the adjournment to that day having been made solely to enable Mr. Wm. Fairbairn, M. Inst. C. E., and Mr. David Bellhouse, both of Manchester, to prepare an elaborate report as to the cause, or causes, of the fall of this fire-proof mill.

On the assembling of the jury, on Monday, Mr. Fairbairn presented to the coroner the joint report of himself and Mr. Bellhouse; and, in doing so, said—"The object which Mr. Bellhouse and myself had, in drawing out this report, was, in the first instance, to determine the true cause of the accident, and also, at the same time, to lay before the jury such facts as will enable them to come to a correct verdict. We have probably gone further into this inquiry than is usual on such occasions; but, if the report be considered too long, it may be curtailed—and with your permission, sir, I will read the report, as I may have observations to make as I go along.—The Rev. T. S. Mills: You have entered into all the facts bearing on the defects in the structure? Mr. Fairbairn: Our object has been two-fold; first to inquire into the

true cause of the accident; and next, to set the public right with regard to the construction of fire-proof fabrics in future."—[Mr. Fairbairn exhibited the plan of one floor of the mill, as to its bays, principal and cross beams, and arches, in order to aid in his explanations; and for the same purpose we have given below a copy of the diagram embodied in the joint report of Messrs. Fairbairn and Bellhouse.]

Mr. Fairbairn then proceeded to read the report as follows, adding explanations as he went on, to the following effect:—

"In consequence of a unanimous expression of feeling on the part of the coroner's jury, that a full and satisfactory inquiry should be made into the causes which led to the death of Joseph Tweedale, and others, at Messrs. Radcliffe's cotton mill, Oldham, on Thursday last: —we, the undersigned, have carefully examined the building, and, having noted every particular relative to the walls, foundations, iron beams, columns, and their fractures, are of opinion that the accident has arisen from one or two causes, namely, from the falling of one of the arches in the first instance, or, what is more probable, from the breaking of one of the large beams supporting the transverse and longitudinal arches at the extreme gable of the mill.

"From the evidence already adduced, it appears that one of the arches in the top room (the fourth from the old mill) was observed to sink some days previously to the accident which subsequently occurred; this arch, which had sunk about four inches, was considered unsafe, and the necessary preparations for refixing the centres were immediately taken for its renewal. During the rebuilding of the arch (of which about one-third was completed, the middle being removed, and the other remaining,) the building at this critical period gave way, and, as stated by one of the witnesses, the beam broke short by the column, and the whole came down with a crash. Now in this view of the case, (and assuming the evidence to be correct,) it is obvious, the beam must have broken from the lateral strain of the arches, and not from the weight acting vertically (as assumed) upon the beams which remained. In confirmation of this opinion, it will be observed, that the middle beams were unprotected from the lateral thrust, unless we except an imperfect wooden stay, which, from its soft and fibrous nature, would easily split, or crush, by the force of the edge of a flanch of only one inch thick pressing upon it."

In order to explain this more clearly, it may be necessary to refer to the plan a little. This [marked bay 3 in the plan below] is the arch where the accident is said to have commenced. The north third of the arch had been taken out and renewed; the middle third was taken out altogether when the building fell; and the south third was the old arch, as it had sunk. The middle beam [that between bays 2 and 3, marked *b*, and thirteen feet ten inches in length,] broke off at the collar [at the north end.] Two square pieces of wood, 4½ inch scantling, were put across at these points only [indicating them,] bearing upon the lower flanch of the beam; consequently, if any lateral thrust took place from the adjoining arch, or arches, [marked 2 and 4 on the plan,] its tendency would be either to split the wood, or to crush its fibres, and thus to cause the beam to break. That is

one way of accounting for it. I am, however, of the opinion myself, and Mr. Bellhouse concurs with me—that this was not the cause here, but another, which will presently come before you:—

"Hence it follows that the thrust of two wide and flat arches would be quite sufficient to fracture the beam, and thus loosen, or destroy, the abutments on each side. The beam being ruptured, it is easy to conceive the result which must inevitably follow such an event. From the breakage of this beam, we may infer a serious and extensive accident; but to our minds, it does not sufficiently clear up the full amount of injury sustained; nor does it account for the immense crash and total destruction of the building, which ultimately took place."

I believe that the whole building came down almost instantaneously. If I am rightly informed, both the side walls and the gable end fell outwards.—The foreman: Not outwards, but inwards: the walls came principally inwards, like a funnel.—Mr. Fairbairn: But I am strongly inclined to think that the walls would be crushed outwards.—A juror: There is evidence to show that the walls first fell outwards; and, on the south side, a stable and several pigsties, at some distance from the building, were knocked down.—Mr. Fairbairn: I did not hear the evidence; but I made inquiries at the place; and I saw, that, on the side next the engine room, [the north] the walls had evidently, in falling, struck the side of that building, because there were indentations on the bricks. On the other [south] side of the building, again, at a distance of not less than six yards—[several jurors: Oh! considerably more,] some buildings were destroyed by the falling walls; and I was also informed that immense quantities of material had fallen outwards at the gable end. [Indeed, it was here that Whitehead was killed by the materials falling outwards towards the detached chimney at the north-east corner of the building.]—The coroner: Do you not think that the beams pulling the walls inwards would tend to make a collapse? Mr. Fairbairn: if the pillars had given way first it would; but, if the pillars remained, the walls would go outwards.—The coroner: Did you read the evidence of Mills, the beer-seller, who saw the fall from his house? He says,—"On Thursday last I was at my house, facing Lower House Mill. I saw the [north] side next the chimney begin to fall. When the roof had fallen two stories, it made a stop for a second or two. The outer walls then flew in, and it all came to the ground."—A juror: That is, the upper stories fell outwards, and then, the walls breaking, the lower portion went inwards.—Mr. Alexander Taylor, a juror: One of the firm, (Messrs. Radcliffe,) who has not been examined, says that the building began to fall outwards, and ultimately went in: that would be the lower part of the warehouse that went in. Mr. Fairbairn: However, it is not very material; for I do not know that it affects the principal cause of the accident at all, and it is not a question of any great moment.

"One of the middle beams, or any one single beam of the building giving way, could not, in our opinion, have made the ruins so complete; and, having reason to suspect some other cause, we were

induced to institute a still more minute and searching inquiry into the strengths and proportions of other parts of the structure.

"On a careful examination of the fractured beams, and more particularly of those which stretch transversely across the building, at a distance of 15 feet from the extreme gable of the mill, we found a more convincing proof of the cause which led to this unfortunate occurrence.

These beams carry the ends of four other beams, which extend longitudinally from the gable on which they rest, as shown in the following sketch:—

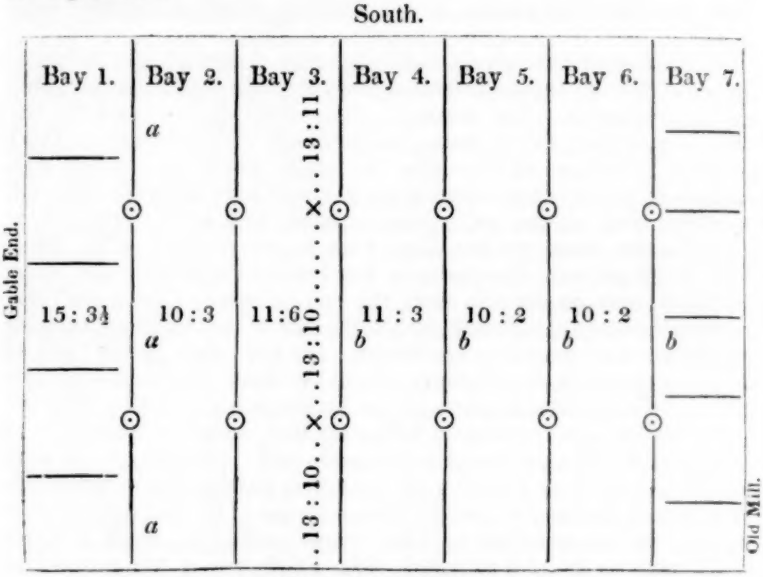


Fig. 1, Plan of Building.

[The figures indicate measurements in feet and inches.]

"From the above it will appear evident that the beams *a a a*, had to support a much greater weight than the beams *b b b*, &c.; and, consequently, they required to be made of proportionately greater strength. They were made stronger, but unfortunately, from inadvertency, *or rather from want of knowledge*, they were strengthened in the wrong place, and instead of adding the additional strength to the bottom flanch, which is always subjected to the greatest strain, it was given to the middle of the beam where it was not required."

Now, with respect to this point, if you take a beam with a single flanch at the bottom ⊥ and break it with the flanch downward, we may call the breaking weight 1000; but, if you take the same beam, and break it with the flanch upward ⊤, you will find that it will only carry a weight of 323 to break it; consequently, there is a deficiency of strength, from merely reversing the position of the same beam, in the ratio of 1000 to 323. But people totally unacquainted with this fact might suppose there was as much strength in the beam laid the

one way as the other. But it is a totally different thing from timber; and cast-iron is a material so extensively used, and of so much importance in the economy of building,—and, indeed, in almost every thing connected with the industrial arts of this country,—that I have taken the liberty of pointing out to the jury the fact of the great difference in strength, in the same beam, between the one position and the other.

"It is well known, or it ought to be known, to every person giving instructions for the form and construction of iron beams, that the strength is nearly a proportional of the section of the bottom rib, or flanch; and, according to Mr. Hodgkinson's experiments, a bottom flanch of double the size will give nearly double the strength."

[Mr. Fairbairn further illustrated the form of the beams by some model drawings, not having any reference to those in Messrs. Radcliffe's mill, but which were made for a mill in Ireland,—that of Messrs. Alexander, near Lough Swilly. In reference to these drawings, he said:] These beams are not correct as to the perfect form of each; but they are as near an approximation as practice will allow; and, if the person who gave instructions in this instance for strengthening the beams, instead of putting the additional metal on the body of the beam, had attached it to the bottom rib, these beams would have been made one-half stronger, or rather more than that; but unfortunately the additional strength, in this case, has been put upon the middle of the beam. In order to explain the nature of this beam, I may observe, that, if you take a beam of any dimensions, and suppose it supported at the two ends, and then lay a weight on the middle, you cannot break that beam without pulling the particles of all the bottom part of the beam asunder, and you must break the upper flanch by compression, or crushing. There is a point called the neutral point, where the particles are neither extended nor compressed; you cannot break it without bending; and you must disturb all the particles by drawing them asunder at the bottom, and crushing them at the top. Consequently, it was found, by the very numerous, ingenious, and laborious experiments of my friend Mr. Eaton Hodgkinson, that the bottom flanch came out a proportion of about one half of the whole section of the beam; and, in the beams in question, the quantity of metal in the bottom flanch is probably not more than from a quarter to one-third of the section. The bottom flanch should be parabolas; and, in order to give it the correct form, this beam would have to be enlarged along the lower flanch, and then it would be of equal strength along the whole line of the beam. I mention this merely to show the necessity which exists for getting greater strength, by throwing the greatest portion of the metal into the lower flanch.

"These facts having been proved by direct experiment, it is important to all those concerned in the construction of fire-proof buildings, in which the lives of the public, and the property of individuals are at stake, that the form of beams and the section of greatest strength should be *perfectly and thoroughly understood;* and to those unacquainted with the subject, we would beg to refer them to Mr. Hodgkinson's paper on the strength of iron beams, in the fifth volume,

second series, of the 'Memoirs of the Literary and Philosophical Society of Manchester.' * In ordinary cases, we should not have troubled the jury with these remarks; but in a case of such importance as the present, where the lives of so many persons have been sacrificed to defective knowledge and skill in the construction of buildings, wherein considerations of such importance are involved, we have considered it our duty thus publicly to direct attention to the subject, not only as regards the present but in all future cases, and respectfully to urge upon the proprietors of mills, and of other buildings containing work-people, the necessity which exists for a more secure and perfect system of building, and for a further development of the principles upon which fire proof edifices are founded. If this suggestion is properly received and acted upon, we have reason to believe, that we shall not again have occasion to investigate occurrences of so lamentable and so distressing a nature. We have already observed, that the beams *a a a*, in the preceding sketch, were strengthened, not, however, in the bottom flanch, but in the middle part of the beam, where they are thickened, and where it was absolutely of no use. Had the same quantity of metal been given to the lower flanch, these beams (the weakest in the building,†) would have carried nearly double the weight; and thus, by a proper and judicious distribution of the metal, the building as well as the lives of the people, would have been saved. These observations apply to all the other beams of the mill, which are also defective as respects their strength."

"In computing the weights upon each beam, it was found that those supporting the arches of ten feet six inches, and those of eleven feet six inches span, had to support a load (without machinery) respectively of ten and eleven tons."

That is, thus:—We compute the weight of the arch at about ten tons for the short span, and eleven tons for the other; and that is about the weight required.

"And those sustaining the ends of the longitudinal beams were acted upon with a load of thirteen and three-fourths tons."

That is, particularly the two shown here [the two outside beams *a a*,] because each of them had not only half the long arch to carry, but also half, or more than half, of the short arches on the other side.

"Now, if we take the sections of these beams, and calculate the weights necessary to break them, when laid upon the middle, it will be found that the breaking weights for the beams *a a a*, and *b b b*, &c. will be nearly the same, or about 9¾ tons. This is the breaking weight of an average quality of iron; and, allowing for the difference of metals, it could not be raised much above 10 or 10½ tons."

They must of necessity be broken with a weight of from 10 to 10½ tons. I have taken the average at 10 tons.

"The breaking weight would, therefore, be about 10 tons when the beam is loaded in the middle, and 20 tons when equally distributed over the whole surface of the projecting flanch of the beam."

* See Journal Franklin Institute, vols. ix and x, 2nd series.

[†Mr. Fairbairn added that these beams were rather weaker in original construction than the transverse beams; and that the whole of them were certainly not such as would be considered safe.]

Now, there is a wide difference between the beam being loaded on one point in or near the middle, and being loaded along the whole beam. In the latter case, it would carry just double the weight. Consequently, you have in arches an equally distributed weight; so that a beam supporting them, and which would break with 10 tons, applied to a single point in, or near, the middle of the beam, will take 20 tons to break it, when the weight is so distributed.

"Having ascertained the bearing of the beams, we shall next compare their strength with the actual loads they were called upon to sustain; and, in making that comparison, it must be borne in mind that the two beams *a a*, next the side wall, had their loads unequally distributed, which reduced their bearing powers to 15 tons."

Now you see that on the west side of the beam *a*, it was equal to carry 10 tons; but the cross beams on the east side threw the whole weight upon the middle of the beam, and, consequently, instead of the breaking weight of the beam *a*, being 20 tons, (as it would have been, if equally distributed,) it was only 15 tons, having a distribution of the weight only on one side, and the weight on the other bearing upon one point only.

"Now the load which these beams had to support was 13¾ tons, 8½ tons being supported on a single point on one side, and 5¼ tons distributed over the surface of the opposite flanch on the other. From this it will be seen, that the actual load was to the breaking weight as the numbers 13.75 to 15, or as 1 to 1.09 being within a mere fraction, or one-tenth, of absolute destruction."

That was the very critical state in which this building was standing, as to those beams, just previously to the fall.

"Viewing the subject in this light, and taking the above calculations as data, we are no longer at a loss as to the cause of the accident. Even supposing the arches to have stood, it will appear obvious that so close an approximation of the breaking weight to the actual load was extremely unsafe, and that, under such circumstances, no precautions could have prevented the rupture of the transverse beams *a a a*, whenever they happened to be subjected to the slightest impact, or any vibrating motion tending to disturb the parts under strain, and eventually still further to lessen their already too much diminished powers of resistance."

It is clear that they must have gone some time, or other. I believe Mr. Bellhouse and I are of the same opinion, that that was the real cause of the accident, that probably from the vibratory action of the mill gearing on being set going, or from some other cause, the slightest shock in the world would fracture either of these beams *a a;* and then it is easy to conceive how the others would follow. It would not only carry the gable end down, but it would loosen the whole of these arches on the same floor, and the whole would soon come down in the mass. It would be impossible to account for the entire destruction of the whole building, unless, by some cause, the whole of the frame work of one floor came down, and one of these beams [*a a*] giving way, would account for that.—The foreman: I called the coroner's attention at the time to the evidence of Mills, taken as he

lay in bed, to the effect, that after the arch fell, where he was working, the whole gable-end fell. This seems to confirm the view taken by Mr. Fairbairn.—The Coroner: "It fell bay by bay," was Mills's expression.—Mr. Fairbairn: Of course, we were not present at the time of the accident. All we can do is to reason upon it from the facts given in evidence:—

"Irrespective of the weakness of the iron beams, which we consider as the primary cause of the accident, we would beg to advert to the tie-rods, which, although sufficient in number and strength, were not judiciously placed, as respects their position, for resisting the strain of the arch, their maximum point of tension at the bottom flanch of the beam; but, that being inconvenient, they should on no account be placed higher than the soffit of the arch; and in this position, they would perforate the neutral axis, and give sufficient security to the arch, without injuring the strength of the beam. Instead, however, of approaching this point, they were on the top of the beam, and 18 inches from the bottom flanch."

Now, with respect to the tie-rods, instead of their being placed above the arch, the true position of the tie-rods should be below, forming the chord of an arc. But that, especially in low rooms, would be found exceedingly inconvenient; and, according to the experience of Mr. Bellhouse and myself, we say, that we should never go higher than the soffit of the arch.

"As respects the arches, we found the versed sine, or rise of the arch, too low; on most occasions they are 1¼ inches to the foot."

We generally prefer an inch and a half rise to every foot of span, if it can be obtained. If this be done, you will find the arch come out a very fair and correct form of arch: and it is only at the sacrifice of an inch or two in the floor, which would not be an object, compared with the security of the arches. I do not know that this has any reference to the present inquiry, except that it is a proof that the arches were too low.—Mr. Bellhouse: I think it bears directly upon it; because the arch in the top story gave way or sunk, simply from that cause,—a want of sufficient rise.—Mr. Fairbairn: I have already stated, that we had two objects in our inquiry; the one to trace out the true cause of this accident, and the other to direct public attention to these facts, in order to prevent not only the loss of property, but, above all things, the loss of life. In this latter view, every thing bearing on the construction of these buildings is important.

"As respects the arches, we found the versed sine, or rise of the arch, too low: on most occasions they are 1¼ inches to the foot. But, in order to insure perfect security, we should advise, in all future buildings of this description, that the rise be 1½ inches to every foot of span. In the arch which first gave way, the rise was only a small fraction above an inch, having a rise of only 12 inches in a span of 11 feet 6 inches."

[The Foreman suggested an alteration in the report (which is made above,) to prevent any mistake as to the supposition that the proportion of rise was the same in all the arches; and Mr. Fairbairn observed that, of course, a rise of one inch in every foot of span would be a

greater rise in that arch which was only 10 feet 2 inches, than it would be in that which was 11 feet 6 inches. The correction was accordingly made, and Mr. Fairbairn resumed reading.]

"On viewing the columns, several imperfections were observed in the variable thickness of the metal; but, in other respects, the pillars were satisfactory, and presented no features of weakness indicating danger from those parts: one inch more in diameter, with the same weight of metal, would, however, have given greater security and greater strength."

On the whole it would have been better, probably, if the pillars had been a little larger.

"We cannot close this report, without adverting to the anxious solicitude of Messrs. Radcliffe, and the strong desire evinced by those gentlemen, to have every part of the structure upon the first and strongest principle; and we should imperfectly discharge our duty, if we neglected, on this occasion, to bear testimony to the superior strength of all parts of the building, except those we have just described, and on which it could not be expected they could form an opinion."

We cannot expect that gentlemen who are not acquainted with the principles of building should have an adequate knowledge of all the proportions, and as to what is necessary on such an occasion.

"In conclusion, we have great pleasure in stating, that it appears to us that no pecuniary considerations whatever were present to the minds of Messrs. Radcliffe in the due and perfect construction of these mills.

"WM. FAIRBAIRN,
"DAVID BELLHOUSE.

"Manchester, November 6th, 1844."

In addition to the above, we have procured drawings of the girders, to farther illustrate Messrs. Fairbairn and Bellhouse's report and observations.

Fig. 3.

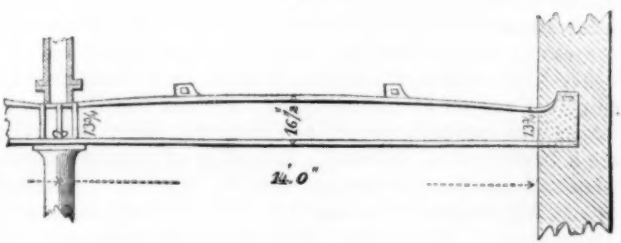


Fig. 4.

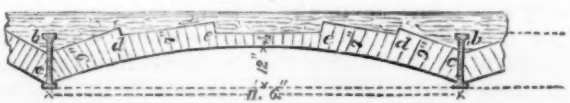


Fig. 2.

Fig. 2, section of beam supporting cross beams at the end of the mill. Depth in the middle, 16½ inches; depth at the end, 13¾ inches; bottom flanch, 6 inches by 1⅛ inch thick; top flanch, 3 inches by ⅞ inch thick. Fig. 3 is a rough sketch of the form of one of the wall beams, and the others being nearly the same it may be taken as a fair average of the whole.

The longitudinal beams which rested on the extreme gable were ½ inch deeper in the middle. The arch tie rods, of ⅞ inch square iron, were at the top of the beams, as represented by the holes *a a a*, (fig.3,) whereas they are generally fixed in the position as under, at *e e*, (fig.4.)

From the above it will be easy to conceive the nature of the building, and the mode of construction in general use in these districts.—The arches, it will be observed, are composed of a brick length from *c* to *d*, ¾ brick from *d* to *e*, and half brick in the centre. The top of the arches is then filled up with a concrete of lime and ashes, on which is laid either the stone flagging or tiles, as the case may be.

The verdict of the jury was accidental death.

Lond. Civ. Eng. and Arch. Journ.

Explosion of a Locomotive Engine on the Manchester and Leeds Railway.

We have been so desirous of investigating the cause of the most unhappy event of the explosion of the *Irk* engine, that we have taken no ordinary pains to get at the facts. We have obtained a copy of the written evidence of Mr. Fairbairn, the maker of the engine, a gentleman well known in the scientific world, and much esteemed for his integrity and honour. We have also written to one of our ablest judges of a locomotive perhaps in England; and from the account of this gentleman in connexion with the evidence of Mr. Fairbairn, we are quite satisfied there was no flaw in the metal; and that the accident arose from the fastening down of the valve. Our correspondent says, the boiler was strong enough to bear 150 lbs. per inch. This gentleman shows how accidents of this kind may easily occur, and how to prevent them, which we hope will be attended to.

The jury have returned a verdict of £500 on the engine, and wanted to return a verdict of manslaughter against the Directors, which the Coroner very properly would not receive. Why, this Manchester Jury are a bonny set of fellows! A verdict of manslaughter against the absent master, because the servant, by improper conduct, blew his property up and killed himself! ! Can Manchester really boast of 12 such sages? We advise them to re-assemble and, to crown their folly, to bring in another verdict of manslaughter against the steam, that really did the mischief, and issue a warrant for its apprehension. It is really a pity men should be so silly.

Mr. Fairbairn's Evidence—I have carefully examined into the cause of the late accident on the Manchester and Leeds Railway, and as that occurrence involves considerations of the utmost importance as respects the public safety, I have been induced at the request of the

Chairman and Directors of the Company, as well as the Coroner, to investigate the subject with more than ordinary attention.

Conformable with these instructions, I visited the spot where the accident occurred, and from a cursory view of the upper part of the copper fire-box, it appeared as if an old crack or flaw had been present, and that part being the weakest would, as a matter of course, be the first to give way. A closer view of the ruptured parts, however, proved this impression to be erroneous, as by careful inspection the copper was found not only perfectly sound, but free from cracks and flaws of every description. This conclusion was fully confirmed on comparing the edges of the plate, which on one side gave indications of an old crack, with the corresponding part from which it was torn. By this comparison it was found perfectly sound throughout the whole length of the fracture and thickness of the plate; but it did not account for the discoloured appearance of the fracture on the opposite side of the plate, which, as before stated, indicated an old crack. A little reflection will, however, shortly explain this apparent discrepancy, and that particularly if we bear in mind the position of the plate, and the nature of the rupture where it first gave way, and where it was ultimately forced down like a piece of paper upon the front of the tubes. If, for example, we suppose the incumbent pressure of the steam to be greater than the resistance of the plate which forced the top off the fire-box, the result would be a forcing down of the weak part and a subsequent and rapid, if not almost instantaneous, rupture of the whole of that part, and an equally rapid turning downwards of the two others which form the rectangle of the fire-box. Now in the act of tearing, it is obvious that the steam and water would be discharged with great force upon the fire, which mixing with the gases and carbon of the furnace, would form a coloring matter sufficient to give those appearances to the fractured edge of the descending plate. From this it is evident that the present appearance of the ruptured edge of the plate is no indication of unsoundness in the material, which is fully proved by the clean and perfectly solid metal from which it was rent at the top bend of the fire-box on the opposite side.

Fig. 1

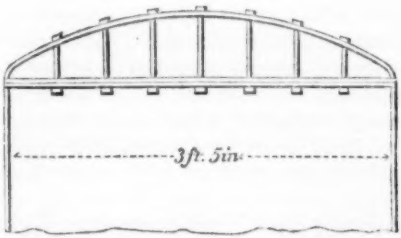
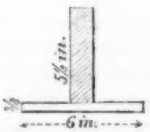


Fig. 2.



Having shown that the accident did not arise from any defect in the metal of the fire box, I would now request attention to the iron bars or stays which extend longitudinally over the metallic cover of

the fire box. These stays are seven in number, and 4¾ inches deep in the middle, by 1¼ thick, and are strongly riveted with seven ¾ bolts, through the copper ⅜ of an inch thick. These seven supports were fixed equidistant from each other or about 6 inches apart from centre to centre. They are also 3 feet 4¾ inches long, and rest upon the dome, as in figure 1.

From this it will be seen that the stays or bars were ¾ of an inch shorter than the length of the fire box, owing propably to the rounded corners of the dome, which did not admit of the ends of the stays fitting upon them. Now in seeking for the cause of the accident, from defects in these parts we shall find ourselves equally at a loss in accounting for results as we were in our previous disquisition on the quality of the copper which may be proved by calculations as follows:

Suppose each of the malleable iron stays, supporting the roof of the fire box, to be a series of separate beams or girders subjected to a given strain, and taking each as equal to a beam whose bearings are 3 feet 4 inches asunder, we then have a compound beam of malleable iron, and copper of the dimensions as in figure 2.

Now as the pressure is uniform and equally distributed over the whole surface, we have by the formula (after allowing for the difference of the strengths in the metals,) a force of 20.7 tons as the breaking weight, uniformly distributed over the surface. This calculation is made under the supposition as if each of the bars were subjected to a separate strain, whereas they are connected by the union of the lower flanches, thus giving a resistance in every direction to the internal pressure from above. If we, therefore, take each of their separate efforts to resist a destroying incumbent force at 20 tons, we then have $20 \times 7 = 140$ tons as the ultimatum pressure for separate beams, and supposing double strength to be gained by the union of their lower flanches of solid copper, the correct resisting force of the top of the fire box to rupture would then be 280 tons. Now 60 lbs. on the square inch would give 43.35 tons acting upon the top of the fire box; and hence would follow a pressure of 387.6 lbs. upon the square inch, which would be required before the top of the fire box and its supports could give way.

As a further proof of the strength of this part of the structure, let us again take the tensile force of copper (which of the best quality is about 23 tons to the square inch; but, taking it at 20 tons,) and it will be found that the resisting force to the rupture of one side alone will be about 310.8 tons. It is therefore obvious, that in order to force down the top of the fire box (on that side which apparently first gave way,) a force of 310 tons would be required, and an equal force of 280 to 300 tons would be necessary to break the iron stays or bars supporting the cover of the same.

Having endeavoured to establish the fact of sufficient strength in the ruptured parts of the material, and having explained the nature of the construction, so as to show that the accident could not arise from that cause, I would now respectfully direct attention to another part of the subject which appears to me to bear directly upon the ques-

tion. It must appear obvious to every person conversant with the subject, that a heavy body, such as a locomotive engine, of 15 to 16 tons weight could not be projected to a height of 25 to 30 feet, without the agency of an enormous force. That power could not be maintained by the strength of the material, nor yet by its distribution, however well-arranged, in the construction. We must, therefore, look for it in some other quarter, and endeavour satisfactorily to prove, that the effects exhibited in this lamentable occurrence, do not, in any instance, disagree with the causes which produced them. In this inquiry, some curious and interesting scientific phenomena present themselves. First, to account for the instantaneous elevation of such a ponderous body as a locomotive engine, to a height of 30 feet; and, secondly, to demonstrate and explain the causes which produced that elevation.

In approaching this investigation, it would require the aid of a profound mathematician; but, that being a work of time, I must trespass upon the patience of the jury whilst I endeavour to make the most of what I have got, and to show, that the task is probably less difficult than appearances at first would indicate.

An eminent writer on mechanical philosophy states, "that forces are of themselves imperceptible, and are seen only in their effects, or what measures they effect." Now, according to the laws of gravitation, that force which accelerates the descent, and retards the ascent of a body, must be considered as a constant uniform accelerating or retarding force. Therefore, the motion of a falling body projected downwards, is uniformly accelerated, and that of a body projected upwards, is uniformly retarded; that is, the required velocities are as the times in which they are acquired by falling, and the extinguished velocities are as the times in which they are extinguished. Hence it appears, that the spaces described by a falling body, are proportional to the squares of the times, from the commencement of the fall, and the spaces described by bodies projected upwards, are as the squares of the times of the ascent. It therefore follows, that the same laws that govern the descent, also regulate the ascent of bodies; and, having these fundamental principles in mind, I apprehend we shall find less difficulty in solving the question by the simple law of projectiles. Taking, therefore, the forces of projection as equal to those of gravitation, and supposing a body such as the locomotive engine in question, 15.5 tons, falling from a height of thirty feet (which may fairly be taken as the height of the ascent,) we then have the square of $30 = 5.473 \times 8 = 43.780$ for the velocity in feet per second, or as the force with which a heavy body falling from that height would strike the ground. Now assuming the force of impact to be as the velocity multiplied into the weight of the falling body, we again have $43.780 \times 15.5 \times 2240 = 1520041.6$ lbs., or 655.7 tons, as the momentum or measure of contact with which a body of that weight would strike the ground in its descent from a height of 30 feet. Let us now reverse the proposition, and suppose, that instead of an uniform accelerating motion produced by gravity, we have to encounter its equally uniform functions of retardation; it then follows that the same momentum

of force with which the descent was terminated, would be required to raise it to the same height. It is therefore, evident, upon this hypothesis, that a projective force of 1520041.6 would be required to elevate an engine of 15¼ tons to the actual height of 30 feet, in order to demolish that part of the roof removed by the explosion.

Let us now compare the forces of projection, or the powers which operated, upon the engine in its elevation to the height already named; and it will be found that 1563821 ÷ 1619.5, the area of the fire box in square inches = 939 lbs. upon the square inch. Now this pressure is more than double the strength of the fire-box, or any parts of the boilers containing the elastic force; but supposing the top to give way with 250 to 300 lbs. on the square inch, it then follows that the additional force must have been generated in the act of the explosion, by the intensely heated water and steam rushing upon the fire at a considerable higher temperature. We are all acquainted with the effects of water thrown upon a red hot fire, and the explosive nature of the volatile vapours which are thus generated by the combined action of the gases and water. The effects would be more tremendous in the case before us as the water in the boiler contained, previous to the discharge, a large proportion of heat, and the calorific effects would be a proportional to the pressure of the steam at the time when the rupture occurred.

I am not sufficiently acquainted with theoretical chemistry, to prove that this solution is correct, but I am happy to find most of my professional friends agree with me in that opinion; and, in the absence of more convincing proofs, I am disposed to consider the reasons and demonstrations already given, as the cause of the accident, which I regret to find has been attended with the loss of life.

As a further corroboration of these views, I may perhaps be permitted to advert to the prodigious power of fixed gunpowder, which is nearly 1000 times greater than that of the atmosphere, which, taken at 15 lbs., gives the enormous force of 15,000lbs. or above 6 tons to the square inch. This is very far above our computation, and looking at the position of the engine and the depth of this fire box, we may readily compare it, along with the pit below, to the breach of a mortar in throwing a shell, whence the projectile is discharged instantaneously on the firing of the powder, and the elastic force of the expended fluid. Such was nearly the case with the *Irk*, which, on the instant of the explosion, left at the bottom of the pit indelible impressions of a powerful recoil.

Viewing the circumstances of this extraordinary case in all its bearings, I am led to the conclusion that the question resolves itself into two considerations in connexion with the cause of the accident. First, that the top of the fire box was forced down upon the furnace by excessive pressure arising probably from accumulated force of the steam having no outlet through the safety valves; and secondly, by a process of inductive reasoning from the force of a body of water and vapour, at a high temperature, being discharged upon the evolving gases and glowing embers of the furnace, whereby the carburet-

ted hydrogen, and carbonic oxide gases, were charged with their equivalents of oxygen, and explosion ensued.

The above appear to be the only principles upon which we can account for the extraordinary effects indicated in the rupture of the metallic plate in the first instance, and ultimately in the explosion and subsequent force which carried the engine from its primary position to the place where it now rests.

In closing these observations, I would respectfully intimate that the subject is one of vital importance, not only as regards the Proprietors and Directors of railways, but the public are deeply interested, and have a right to demand every security which the experience of the last 15 years can afford, either in the transit or the machinery by which that transit is effected.

It is for these reasons that I venture to recommend a searching inquiry into every circumstance connected with the present accident, and conceiving that a full and complete elucidation of this subject may not, on this occasion, be afforded, I would further suggest that a series of well conducted experiments be entered upon for the purpose of ascertaining the cause which led to the present and late accidents on the South Eastern Railway, and for determining some fixed principle of action whereby the lives of the public may be secured, and the Proprietors of railways relieved from a tax which bears with equal severity upon their reputation as well as upon the revenues of their establishments.

In the acquirement of these objects a mass of valuable information would be obtained, and our knowledge of an intricate subject greatly extended, to say nothing of the advantages which this enquiry would confer upon science. If done at all, it should be done at the expense of the different Railway Companies; and probably it could not be entrusted to better hands than the British Association for the advancement of science.

In answer to the questions of the coroner, he said he did not attribute the accident to the shortness of the longitudinal bars in the fire box. He examined the spring, balance and valves, and they appeared good. He said one of the valves was at the command of the driver, and could be screwed down by him; if he had done so, and the safety, or lock-up valve, had been down also by any unknown cause, an explosion would, as a matter of course, follow. He said the same consequence would ensue if only one of the valves had been closed, provided the steam was generating very rapidly. He heard that, for the purpose of getting up the steam very fast, the valve, at the command of the driver, had been screwed down. From what he saw of the fire box, it appeared perfectly square and sound, as well as all parts of the boiler. He looked, he said, very carefully—at first it appeared as if part of the fire box had been cracked; but on comparing the fractured parts, it was afterwards found the copper had every appearance of being sound and good metal, and of sufficient strength. Mr. F. said the *Irk* was made in January, 1841, and had been in the use of the Company from that time. The driver, he said, could not screw down the lock-up valve. The lock-up valve would have

opened unless something had prevented it. His opinion was that the accident arose from excessive internal pressure, forcing down the top of the fire-box, and from the explosion of the gas as stated in the report. The corresponding piece of copper which Mr. Fairbairn had taken away with him on the morning of the explosion was then produced for the inspection of the jury. Mr. F. pointed out the part which corresponded with the blackened edge of the other part of the fire-box, and it appeared perfectly sound, without any signs of a fracture.

The following is the letter referred to in our introductory remarks. —"I have pleasure in affording you such information as it is in my power to give respecting the construction of the fire-box of the Manchester and Leeds Company's engine *Irk* which exploded the other day. The inside shell of the fire-box is made of copper three-eighths of an inch thick (the tube plate was of course thicker.) The dimensions of the horizontal section of the inside shell are 3 feet 5 inches × 3 feet 3 inches. The sides of the inside shell are well stayed to the sides of the outside (iron) shell by bolts placed, say 5½ inches apart. The roof of the inside shell is flat, and is stayed in the usual manner with strong bridging bars, seven in number, each being 5 in. deep by 1½ in. thick, and extending from back to front over the roof of the inside shell. The whole was most strongly stayed, and was of ample strength, I should say, to sustain a pressure of 150 pounds on the square inch, or more than twice the working pressure. There was no defect or flaw visible. The sketch below, may, perhaps, serve to explain to you the mode of construction, which is similar to that adopted on the Liverpool and Manchester Railway.

Fig. 1.

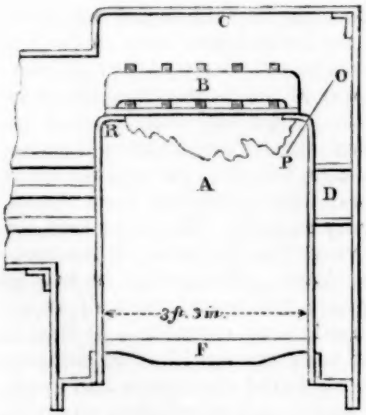
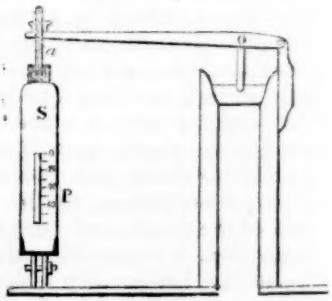


Fig. 2.



A, inner casing of fire-box; B, bridging bars; C, outer shell of casing; D, fire door; F, fire bars.

The fracture took place along the angle intersected by the line O P. The edges of the plates along that angle were as if cut clean by a pair of shears. The entire roof came down like a door turning on its hinges, as on the centre R. The sides of the inner shell were torn by the fracture into saw teeth. It was certainly a defect in construction not to make the bars B. long enough for their ends to rest upon the extreme angle at O P and R, and accordingly this angle has proved to be the weakest part; but this fact is not sufficient to account for the explosion, which, if I may hazard an opinion, is only to be explained on the assumption of an excessive pressure of steam in the boiler. Constructed as I understand the safety valves were, and as those of too many locomotive engines are, nothing is easier than to render them absolutely useless. You have only to screw the nut until the index pointer reaches the bottom of the scale, where it is stopped by coming in contact with the end of the slip in which it travels, and you make the safety valve a fixture, which no pace, short of one sufficient to break or bend the lever, can move.

The remedy which puts the control of the safety valve beyond the reach of any workman, is to put a small collar or ferrule over the screw at *a*, fig. 2, so as to prevent the index pointer P from ever reaching the bottom of the scale, screw the nut as you may. When the steam begins to blow off strong, the workmen have a strong temptation to put on extra pressure to prevent noise and waste of fuel. S represents Salter's balance. Herapath's Jour.

Description of the Great Britain Steam Ship.

Though many descriptions have been given of the Great Britain, we are induced to insert the following, as being the most clear and succinct that we have seen, and which we copy from an interesting pamphlet just published by Capt. Claxton, entitled "A Description of the Great Britain Steam Ship," &c.

The length of the keel 289 feet. Total length, 322 feet. Beam, 51 feet. Depth, 32 feet 6 inches. Feet of water when loaded, 16 feet. Displacement, 2,984 tons. Tonnage by Old Measurement, 3,443 tons. Plates of keel nearly one inch thick. Plates of Bottom varying to ¾ of an inch at extremes, and to ⅝ths generally. Topsides ½ an inch, and at the extreme aft 7-16ths. The ribs are framed of an angle iron, 6 inches by 3½ inches; ½ inch thick and 7-16ths. Distance of ribs from centre to centre, amidships, 14 inches, increasing to 21 inches at the ends.

Ten iron sleepers run through the engine rooms, gradually diminishing in number, to the fore end of ship and under the boilers, the platform of which they support—in midships they are 3 feet 3 inches in depth, supported by angle irons in the form of inverted arches, and a short distance from each other. She has five water-tight partitions. Stows 1200 tons of coal. 1000 tons of measurement. The engines weigh 340 tons. The boilers 200 ditto, and hold 200 tons of water. The main shaft is 23 inches in diameter in the centre, and 24 inches

in the bearings; in the rough before turned, it weighed 16 tons. It has been lightened by a hole of 10 inches diameter, and bored through. A stream of cold water passes through the cranks and this hole when the engines are at work. The screw shaft is in one long and two short, or coupling, parts. The part next the engine, solid, 28 feet by 16 inches diameter. The hollow intermediate shaft 65 feet, by 2 feet 8 inches diameter; the screw part is 25 feet 6 inches, and also 16 inches diameter; the total length is 130 feet, and it weighs altogether 36 tons.

The screw is of six arms, 15 feet 6 inches in diameter, 25 feet pitch, and weighs 4 tons. The main drum is 18 feet diameter, and drives 4 chains, weighing 7 tons. The screw shaft drum is 6 feet in diameter, and the weight with the pull when working is equal to 85 tons on the bearings of the main shaft. The cylinders are four in number, 88 inches each. Stroke 6 feet. Power 1000 horses. The condensers are of wrought iron, 12 feet by eight, and 5 deep. Under the whole space of the engines, up to the top, the angle irons are doubled. The upper, main and saloon decks are of wood, the two cargo decks are of iron. The officers and seamen are all accommodated on two decks under the forecastle.

From the ship's bottom to the upper deck, runs on either side, for the whole length of the engine and boiler space, a strong iron partition forming below the coal bunkers; and above, the servants' accommodations on one side, engineers' cabins and stokers' accommodations on the other, besides 26 water-closets. She has six masts, fitted with iron rigging, adopted in consequence of its offering two-thirds less resistance than hemp,—a great point going head to wind.

The plain sails of a 52-gun frigate, that is, without bunting, royals, stay-sails and steering sails, number something short of 5000 yards of canvas, and the plain sails of the Great Britain amount to 4,943 yards. She carries four large life-boats of iron, and two boats of wood in the davits, and one large life-boat on deck; they are built according to a patent taken out by Mr. Guppy, and are capable of carrying four hundred people. **Nautical Mag.**

Description of Ellis's Turn-Table. By B. Rotch, Esq. V. P.

This ingenious invention obviates one of the greatest objections to the turn-table, which is, its being supported on numerous small friction-rollers under its outer edge, as well as on a central pillar. The object of these rollers is to facilitate the turning of the table when the heavy weight of an engine or carriage is upon it; but this weight is so excessive, that coming, when passing over the table unequally, first on one edge, as it enters upon it, and then on the other, as it passes from it, the table gets pressed down, first on one side, and then on the other, with such rapidity and violence of strain as to cause a great noise of successive jarring blows, and a constant derangement and damaging of the rollers.

Ellis's turn-table prevents all this, by doing away with these rollers,

and allowing the outer edge of the table to rest firmly, and without rollers, on a solid support, or circular bed, made to receive it. It is also supported on a central pillar, on which the centre of the table bears firmly and steadily at the same time. When the table is left in this condition, which may be called its position of rest, the bearings are so firm that the engines and carriages roll steadily over it without noise or jar, just as if it were a part of the railway itself; but the central pillar is so arranged as to be easily acted upon by a compound lever, on the principle of the lever of a weighing machine, and the table may, in fact, be made into a weighing machine by adapting a steelyard and weights to this compound lever; and, when it is required to turn a carriage or engine on the table, it is rolled on to it while remaining firmly and steadily in its rest position, and, when the weight is placed on its centre, and has an equal bearing over the table, the table is lifted from its circular bearing all round the outer edge by the compound lever, and thrown entirely on the centre pillar, the bottom of which resting on a pivot, the whole may be turned round with the greatest ease the distance required, and the table then let firmly down again on its solid circumferential and central bearing, or to what is called its rest position.

This plan is very simple, very effective, and saves an immense amount of wear and tear in the item of turn-tables. It has already been extensively adopted. Trans. Soc. Arts.

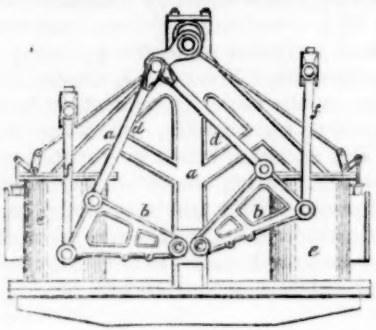
Ancient Tunnel.

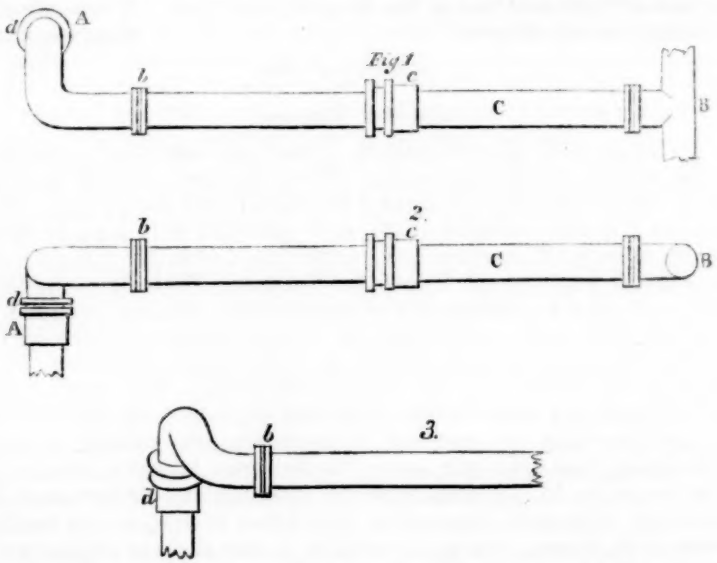
According to the French papers, a new and remarkable assertion of the powers of ancient practical science has been brought to light, in the city of Marseilles, to dispute the triumphs of the present. That town is, it seems, suddenly about to be endowed with a ready-made tunnel, of larger dimensions and greater extent than Mr. Brunel's extraordinary performance below the Thames. There has long been known to exist a subterranean passage, which tradition reported to lead from the parish of St. Victor to an issue beneath a tower in the fort St. Nicholas,—passing, therefore, at the mouth of the port, under the deep sea, where float the line-of-battle ships! For many years, the termini have been encumbered with rubbish; and no one had ventured to verify the tradition by attempting the perilous passage. This daring, and even rash, enterprise has been, however, successfully achieved by M. Joyland, Engineer of Roads and Bridges, and M. Matayras, architect. Repairing, with some friends, to the ancient abbey of St. Victor, they penetrated, by a long flight of steps, to the bottom of the tunnel; and, clearing the way before them, finally emerged by the Port St. Nicholas! The work, which they suppose to be Roman, is, they report, in nearly perfect preservation. A few parts only are in want of repairs, whose cost they estimate at not more than from 16,000*l.* to 20,000*l.*; and proper approaches are all that will then be wanting. The tunnel is a single arch, has a width of more than sixty feet, and is one fourth longer than that of London!

London Athenæum.

Explosion on board the "Gipsy Queen."

It is our painful duty to record a frightful and fatal accident which occurred on Tuesday, Nov. 12, involving the death of Mr. Jacob Samuda (well known on account of his connexion with the Atmospheric Railway,) and nine other persons on board the steamboat the *Gipsy Queen*, lying at the mooring buoy, off Brunswick Wharf, Blackwall; in consequence of one of the joints of the steam-pipe leading from the boilers to the cylinders giving way as explained in the evidence hereafter given. The *Gipsy Queen* is a new iron boat of about 500 tons burthen, recently built by Messrs. Jacob and Joseph Samuda, with a pair of engines of the collective power of 150-horses (nominally) on the bell-crank principle as patented by Mr. Jacob Samuda. For the sake of reference we again give the engraving.





It appears from the evidence that the explosion was in no way connected with the construction of either the engines or the boilers, but simply in the method of making the joints, or rather in the fixing of the steam-pipe leading from the boilers to the cylinders. On the day of the accident the vessel ran down the river to try the engines, which it is stated worked admirably and perfectly satisfactory to all parties present, that during the trip the steam was not more than 10 lb.

pressure, although the safety valves were represented to have been loaded with 25 lb. on the square inch; after the vessel had made the trial trip, she was moored off Blackwall, when Mr. Jacob Samuda felt desirous to try what effect high steam at 25 lb. pressure would have upon the boiler; it was during this experiment that the fatal accident occurred. In order to render the evidence intelligible, we have borrowed of our contemporary, the *Mechanics' Magazine*, the four annexed engravings, showing the pipe and the joint.

Fig. 1 is a plan, or top view, of the pipe. Fig. 2 a side view.—Fig. 3 a perspective of the bent pipe at the angle. A is the vertical pipe leading to the cylinder; B the steam-pipe from the boilers; C the intermediate steam-pipe; *b b* joints of the flanch description; *c* and *d* socket or spigot and faucet joints. Fig. 4 is an enlarged view of the socket or spigot and faucet joint, *d*, being the one which is represented as having given way first; the part indicated in black is the place occupied by the ring or bead which was originally on the end of the pipe, and in the evidence stated to have been *chipped* and *filed* away; the joint was packed with hemp and tallow, and surrounded with a *gland* to prevent the packing being forced out by the steam. It is very evident from this description, that we have a packing very similar to that round a piston rod, and in consequence of the bead being cut away, a very low pressure of steam would lift the elbow pipe out of its place; if the pipe be 10 inches diameter the area is equal to 78½ inches, and with a pressure of steam at 10 lbs. there would be an upward pressure of 785 lbs.; consequently, if the pipe was not strapped down, it is very evident that the elbow pipe would be lifted out of its socket in the manner the accident is represented to have occurred. There appears to be some astonishment exhibited by all parties at the inquest, at the bead being cut away and filed, but not a word was said about the *gland*, if the latter was in one piece it is evident that the bead was cut away to get the gland on the pipe, but if the gland had been made with two semicircles and a ring under, also in two pieces, and placed so as to break joint, it might then have been put on without the bead being cut away; if the annexed drawing be a correct view, of which we have no doubt, it is very evident that the gland was in one piece, and consequently it accounts for the chipping away of the bead on the end of the pipe. It is also stated in the evidence that the spigot and faucet joint is necessary to allow for expansion of the metal; for this purpose ½ to ¾ of an inch in a pipe 30 feet long, would be ample play, and in a vertical pipe 10 feet long, ¼ of an inch; but the principal necessity of such joints is to avoid derangement when the vessel *takes ground;* in such case iron cement joints, as recommended by one of the witnesses, would give way and be perfectly useless. We, therefore, under all the circumstances, cannot see any objection to the socket or spigot and

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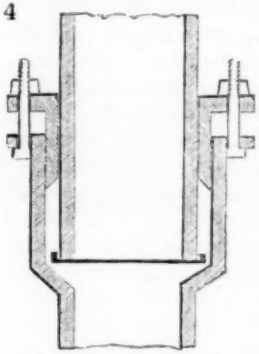

faucet joint, provided it be made with a bead on the end of the pipe, and a proper *gland.* To the defect of the latter do we attribute the fatal accident; having offered these observations, we shall now proceed to quote the evidence given before the coroner, Mr. Baker, at the inquest held upon the bodies of the sufferers.

The Inquest.—Mr. G. Low, an engineer on board of the vessel at the time of the accident, stated that she had two engines worked with two cranks, without an intermediate shaft. They are different from ordinary engines. Are both direct acting engines, and beam-engines. The common beam-engine has cylinders standing athwart the ship, and are parallel with the shafts, but the engines of the *Gipsy Queen* stand fore and aft the boat, with the shafts at right angles, and not parallel at all. Thought that they were not more dangerous than the ordinary steam-engine. The beam of the common steam-engine oscillated in its centre, while the beam in Messrs. Samuda's engine had a motion at the end. In fact, there were two separate beams. He believed that Messrs. Samuda were, in making these engines, under contract to use all the serviceable parts of the engine of an old steamer which the new one was to replace. But whether portions of the old engine were used did not know. Could not say what they were called, as they were not worked up to the power they were intended to be worked at. They were condensing engines. The engines were never working higher than 10 lb. to the inch all the while, he looked at the gauge, till they stopped at the East India Docks. The number of strokes she gave was from 20 to 24 per minute. The safety valve would not rise at a pressure of 10 lb. to the inch. The maximum pressure calculated to go before any mischief might be apprehended was stated by Mr. Samuda at 40 lb. to the inch. He (witness) supposed she was working on Tuesday at nearly 200-horse power. The diameter of the cylinder was 45 inches, and the stroke was (as the reporter understood) 4½ feet. The engines were tried on the Friday previous. She was tried at her moorings. Could not tell what caused the accident. The pipes are perfect at the joints. The pipe is not broken. It is one of the spigot and faucet joints that has been lifted out of its place. Mr. Samuda had no power over the weight in the safety valve; nor any one else. It was in a chest, secure from any person's interference. The weight upon the safety valve was set at 26 lb. Witness differed from Mr. Samuda as to the amount; Mr. S. said it was 26 lb. and he thought it was 27 lb. No steam could blow off at the valve till the pressure was at 26 lb. When Mr. Samuda sent him on deck a very little steam was just oozing out. The motion of the engines had ceased about 10 minutes. The main pipe is joined with what is called a spigot and faucet joint. This was lifted out of its socket. In answer to a question "was there no fastening to the joint? No bolt or screw at all?" witness said it had a packing of hemp. The joint is used to allow for expansion. They were cast-iron pipes, and all these pipes must have these joints for expansion and contraction. Had seen one twice the size. It is the customary mode of joining in all engines that are fitted with cast-iron steam pipes. As already stated, Messrs. Samuda were bound to work up parts of

the engines of the old vessel, and the cast-iron pipes were parts of the old vessel. They used the cast-iron pipes, the air-pumps, and the cross-heads. The engines were in their places before he joined the work at all, and he could not speak at all of the quality of the work.

The Coroner said there did not, from the evidence of Mr. Low, appear to be have been any fracture in the pipe from which the fatal explosion had taken place; therefore, the solidity of the material did not become an important point in the inquiry. There was, therefore, on this head nothing to find fault with as far as the evidence had gone. He, however, thought further information should be obtained about the amount of security afforded by the description of joint that had given way. Judging from the evidence, it did not appear to him that there was anything like security against similar fatal occurrences, if the spigot and faucet joint were used under the pressure spoken of by the witness Low. He, indeed, did not see how, with so inefficient a mode for joining steam-pipes, or packing them, as the witness had described it, fatal accidents could be prevented.

Mr. Low's examination continued—The joint which had given way was 14 or 15 feet (as was understood) from the boiler. Had the pressure never been more than 8 or 10 lbs. to the inch, at which the engine worked on her trip, there would not have been any danger, but the additional pressure put upon her required something more than that fixture (viz. the spigot and faucet joint.) The vessel started with the steam pressure at 6 lbs. and while working her they were unable to get it higher than 10 lbs. Had no doubt that the occurrence was entirely accidental. Mr. Pim, treasurer of the Dublin and Kingstown railway, here asked prermission to put, through the coroner, two or three questions to the witness. He (Mr. Pim) was a friend of the deceased gentleman, Mr. Samuda, and being in town he had taken the opportunity of attending the inquiry to elicit facts upon one or two points. I think, Mr. Low (continued Mr. Pim,) you said the cause of the accident did not arise from any peculiarity in the construction of the engine itself? Witness—The primary construction of the engines had no connexion with the accident at all. Neither did it arise from any peculiarity in the construction of the boiler. Neither had the material of which the steam-pipe was composed anything whatever to do with the accident, because the pipe is whole yet, but were I to make the same pipe of the same material I would not make it in the same form. The material of which the steam-pipe was composed did not at all contribute to the accident.

With the view of having the evidence of other practical men, the inquest was adjourned till Saturday, Nov. 16.

The Coroner said that Mr. Hensman, a draughtsman, on board at the time of the accident, and Mr. Low, the engineer, had given some additional evidence on the inquest held on Friday on the bodies of those who had died after their removal to the London Hospital, which would be repeated. The great question was, how to prevent such accidents occurring in future. A brother to one of the men who had died at the hospital, named Riley, and who was on board at the time, was satisfied that this was an accident; but if accidents from similar

causes were to occur again, it was desirable for persons to know that death from such a cause would then amount to manslaughter. In a case "the King v. Carr," reported in Carrington and Paine, it was held that where a man made a cannon which burst, and it was sent back to him and repaired, and it burst a second time, that death from such repeated accident amounted to manslaughter. So in this case, if an accident from the same cause were repeated, he should have no hesitation in directing a jury to find a verdict of manslaughter. But Mr. Samuda, the engineer and chief owner, having paid the penalty of his life for this imperfectly constructed joint in the steam pipe, he thought it would be harsh to bring in such a verdict against the younger brother and partner in the firm.

Mr. Low then gave additional evidence, that if a collar, or ring, had been on the end of the spigot pipe, it would have allowed for contraction or expansion, without permitting the pipe to be withdrawn from the socket. It was customary to have such a collar. Its own weight would keep the pipe in its place (?) at a pressure of steam of 10 lb. to the inch, but a pressure of 26 lb. to the inch lifted the pipe out of the socket.

Mr. Henry Hensman corroborated the testimony given by Mr. Low in all respects, except this, that he thought the same pipe, if it had been joined with iron cement, would have been perfectly safe. He did not think that provision for the expansion and contraction of this joint was so absolutely necessary, the expansion of the middle joint being sufficient. The joint as made and packed, would have been perfectly safe, if there had been a stay between it and the deck, or if it had been strapped with an iron strap to the engine, so as to prevent the pipe rising from its socket.

A Juryman—Do you happen to know whether this pipe was new, or was part of the machinery of the old *Gipsy?* Mr. Pim—We shall be prepared in a few minutes to show that it was a new pipe cast for the purpose. A Juryman said it appeared to him, on examination, that the head of the spigot pipe had been chipped off. Mr. Low said it also appeared so to him. He was perfectly satisfied if the late Mr. Samuda had known it, he would have condemned the pipe as unsafe. It must have been done without orders, and ought not to have been done. The Coroner—Might it have chipped itself in coming out? The Juryman—No; that was not the case evidently.

The Jury then retired to consider their verdict, and returned in about half an hour, having found a verdict of "Accidental death." They also expressed an opinion that the deaths of the deceased were "caused by the false and improper construction of the joint of the main steam-pipe, in its not being sufficiently secured; and they express this opinion in order that due caution may be used to prevent similar accidents in future, which, it appears to the jury, may be effected by a collar or ring to prevent the severance of the pipes."

At another inquest held on the bodies of Riley, Donovan and Mills, who died after their removal to the London Hospital, the Coroner remarked that he thought there was decided blame with respect to the fatal occurrence, inasmuch as that the steam had been put to 25 lbs.

to the inch, when it was stated that from the parting of the spigot and faucet joint, it was not capable of resisting steam of that power.

The following evidence was given.

Mr. Low was asked one or two questions as to the position of the steam-pipe, and the place of its separation. He explained that the pipe went up from the boiler vertically, then on a line over where Mr. Samuda was standing at the time of the explosion, and turned down to the cylinder. It was in the centre of the longitudinal portion that the spigot and faucet joint was placed, the parts were forced from each other by the pressure of the steam against the elbow. Witness attributed the yielding of the spigot and faucet joint to the great pressure; but he believed if there had been a collar or ring on the end of the spigot, that being encased in the faucet six or seven inches allowing for expansion and contraction, it would have prevented it from being withdrawn.

Mr. Henry Hensman, corroborated, in all points, the testimony of Mr. Low but he would go further than he had done, and say that the same pipe, if joined by iron cement, would have been perfectly safe. —Mr. Low, being here asked if that was also his opinion, answered in the affirmative.—Mr. Hensman did not think any allowance for the expansion or contraction was absolutely necessary. Being asked by Mr. Pim, who attended on behalf of the friends of Mr. Samuda, whether the joint, as made and packed, would not have been perfectly safe, if there had been a stay upon it to keep it in its place, he replied, certainly. There were two U ties to hold up the horizontal portion of the pipe; and if the pipe with the joint as made and packed had been strapped to the engines, it would have been perfectly safe, as the pipe would have been prevented from moving either way. —Mr. Pim—Was not the spigot and faucet joint introduced by Mr. Samuda rather as a refinement to avoid accident, and as an improvement? Mr. Hensman—Yes. And in answer to inquiries if there had not been a ring or collar originally to the pipe which belonged to the old engines, the witness said, he believed there had, but that it was cut off probably because the pipe was too long, without Mr. Samuda's knowledge; and if Mr. Samuda had known that the joint had been fitted in the way it was, he would have had it altered. Mr. Samuda could hardly look at every joint fitted by his workmen, although he was always exceedingly anxious personally to see that the work was done in a proper manner.

Mr. Pim observed that the inefficiency of the joints arose from an error of judgment, and not from a want of care, and a juror observed that Mr. Samuda evidently thought it safe, or he would not have placed himself in the dangerous position that he did.

The jury having expressed themselves satisfied with the evidence, returned a verdict of "Accidental Death."

Wire Ropes.

The efficiency of wire ropes, as compared with hempen, became, in rather a curious way, the subject of legal inquiry the other day, on

the Northern Circuit. A person of the name of Backhouse, employed in the Wingate Colliery, brought an action against the proprietors to recover a sum of money which he alleged to be due to him under the terms of his pit bond. The defendants pleaded that he had been refused his wages because he had refused to work; to which the plaintiff replied that his refusal arose from the defendant's neglecting to supply, provide, and maintain *sufficient* means of descent and ascent, inasmuch as they had substituted for the old hempen ropes in use the newly invented wire ropes, which were unsafe, dangerous, &c. The real question, therefore, which came to be tried was, whether the wire ropes were as secure as the others? The jury decided in the *affirmative*. We quote the following abstract of the proceedings from the *Times*:—

For the plaintiff a great deal of evidence was adduced to show the insecurity of the wire rope. It appeared that the use of wire ropes in collieries dated only since the end of the year 1842, when they were introduced in various parts, both in working inclines, and raising coals from the pit. Those used on the inclines were chiefly round, while those at the collieries were made flat for the greater facility of rolling them on the drum. In the latter end of the year 1842, a rope of this kind began to be used at the Wingate Colliery. It was in use for about six months, when it met with an accidental injury from the engineman carelessly allowing the cage with the coal to be drawn up too far, and thus to come in contact with the woodwork over the mouth of the pit. The effect was to stop the engine, but the rope did not give way. It was, however, taken off to be examined, and replaced by a hempen one. In April, 1843, the wire rope, consisting of 96 wires, was again put up, and was worked in conjunction with another rope of 144 wires. This latter rope met, in June, with an accident, in consequence of the cage coming in contact with the mouth of the pit, and on examination, it was found that one whole strand of six wires was broken, and that other single wires had given way. It was, however, worked until the evening, when it was taken off for examination, and a hempen one fitted up in its stead. Complaints of the other rope were the next day made by the men. It was alleged that single wires were broken in several places, and that as many as five had given way in one spot. This was alleged as a reason for their not descending to their work. Mr. Armstrong, the manager, expostulated with them on the subject, and endeavoured to show them, that though some of the wires were broken, there was nothing that could at all affect its security. Offers were made on one side and the other to refer the question to some competent authority, but they finally could not agree on a choice of the person or persons who should inquire into the matter; and, on the 10th of June, the parties made their appearance before the magistrate. It was there proposed by Mr. Armstrong that the rope should be tested by a machine, if the men would pay the expense; and he finally offered to test it with a weight of 20 tons as it hung in the shaft. It was finally put to the test, with a weight, however, of 10 tons only, the pulley over which it was carried at the top not being, as was alleged, capable of carrying more.

The result of this experiment was not satisfactory to the miners present. They alleged that the rope yielded somewhat with the weight, and that the strands at the upper part opened. The rope was examined throughout its whole length by a Mr. Chicken on their behalf, and it appeared that 19 wires were broken at different parts of its whole length. Of these, five were broken at one spot and four at another. A piece of the rope was cut off and handed over to them as the subject of any experiment they might choose to make.

A Mr. Galloway, who had been for many years engaged in the manufacture of iron, stated, that he examined the rope in question, which was on the scale of 1 cwt. to four fathoms. He was of opinion that the strength of the rope was diminished in proportion to the aggregate amount of wires fractured. He thought the rope might bear a strain of 27 tons when new, but it would be very injurious to it to expose it to a strain at all approaching to that amount as its elasticity would thereby be permanently injured. The breaking of a single wire shows that all are strained, and that the elasticity of the whole rope is impaired. He thought the rope in question might carry 3½ tons, the usual weight upon it, but would not be safe with that weight in case it met with a jerk.

Other evidence was adduced as to the manner in which the rope stood the test of the 10 tons. It was shown that nine ropes had given way in the Coxhoe and Jarrow collieries. In the former case, however, the rope was flat, and consisted of undivided skeins of wire, laid alongside of each other; in the latter, the rope had been lying idle for six weeks in consequence of the turn out.

For the defence, evidence was adduced to show that a portion of the rope was submitted to a strain of upwards of 19 tons before it gave way, that a single strand of six wires was able to carry upwards of 19 cwt., and a single wire 3 cwt.; that with the test of the 10 tons in the shaft it was perfectly elastic, and that the weight rose and fell some inches, and that on examination afterwards it showed no symptoms of any strain. It was further stated, as the opinion of the scientific witnesses, that the diminution of the strength of the rope would not be in proportion to the whole number of fractures, but to the number at one spot. The cohesion of the wires from the twisting of the rope is such, that a wire at the extremity of the rope, fractured 5 inches from that extremity, will not pull out from the rest, but break if a sufficient weight is applied. So much is this the case that a single strand of the rope in question, consisting of six wires, had individual wires divided at different places throughout its whole length, so that every wire of the six was divided within the space of every foot, and yet even in that state it bore a strain of 12 cwt. 3 lbs. before it gave way. The weight usually carried by the rope at Wingate Colliery was three tons and a half.

Evidence was also adduced of the fact of wire ropes being used at various collieries throughout the country, and that they were generally looked upon as much safer than hemp; that they were better, and that any symptom of weakness was sooner perceived.

The Jury, after being for some time out of the box, returned a verdict for the defendants. Lond. Mechanics' Mag.

AMERICAN PATENTS.

List of American Patents which issued in the month of September, 1844, *with Remarks and Exemplifications.* By CHARLES M. KELLER, Examiner of Patents.

1. For a machine for *Shaving and Splitting Wood;* William Rose, Philadelphia, Pa., September 3.

The operative parts of this machine consist of a horizontal wheel, around a portion of which is arranged rollers for conducting the pieces of wood to be split, or shaved, or both together, with the knives and a trough for feeding in the wood. The rollers are placed on vertical shafts provided with pinions at their lower end, that gear into a cog wheel on the shaft of the horizontal wheel. The splitting knife is placed between the periphery of the horizontal wheel and the first feed roller, and is attached to a stock jointed to the frame above, and connected by a loop with the shaft of the feed roller, mid-way between the roller and the lower journal of its shaft, so that when the roller is pushed from the periphery of the wheel, by the thickness of the piece of wood fed in, or forced towards it by a pressure spring (the upper journal working in a slide to admit of this,) the knife will move just half as much as the roller, and thus occupy a position mid-way between the wheel and roller to split the piece of wood in half. The shaving knives are permanently attached to the frame at any required distance from the periphery of the wheel. The upper ends of the shafts of all the rollers work in slides, and are provided with pressure springs. When the pieces of wood are to be shaved thinner at the ends, there is a cam-formed piece, or projection, on the periphery of the wheel, which forces the wood towards the permanent or shaving knives—and for the purpose of shaving the edges of staves and other articles, cutters are jointed to the frame above and below the horizontal wheel, and so arranged that properly formed cams on the wheel, cause them to approach and recede from each other in proportion to the form to be given.

Claim. "What I claim as my invention, is the combination of the revolving wheel and cams, with the rollers and knives for splitting and dressing pieces of wood, as described."

2. For a machine for *Splitting Hoop Poles;* William Rose, Philadelphia, Pa., September 3.

This, in its chief characteristic, resembles the preceding machine, and is for the purpose of splitting without shaving; but instead of feeding and carrying the wood between a wheel and rollers, there are two sets of feed rollers, the lower ends of the shafts of which are geared together, and the upper ends of one of each set work in slides, and are provided with pressure springs. The hoop pole passes in between the

first set, and is presented to the edge of the cutter or knife by the other set, the edge of the knife being between the two rollers, and hung in the same manner as in the preceding machine; the connexion between the shaft of the movable roller and the knife stock being by means of a crutch, or forked bar. The stock is extended below this connexion, and is provided with an oblique adjustable bar, which passes through guides to insure the proper position of the knife.

Claim.—"What I claim as my invention, is the manner of changing the position of the knife, so as to bring its cutting edge to the centre of the hoop pole, whatever its diameter may be, by means of the aforesaid combination of suspended knife stock, crutch bar, and oblique adjustable bar, or other means substantially the same."

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3. For improvements in machinery for *Pressing Bonnet Tips;* Thomas Kendall, New York city, N. Y., September 3.

This is for pressing that kind of bonnets which have the crown narrowed in and then swelled out towards the upper part, or tip. The mould or block iron, on which the bonnet is put to be pressed, is made with two movable parts towards the tip, called the "movable ball," these are placed one on each side of a wedge-like projection on the block, and the outer faces of these pieces are grooved and swelled to give the desired form to the tip of the bonnets, so that when the block is put in and forced down, the movable pieces are forced outward and give the desired form. These parts are connected together by pins and grooves to keep them together and admit of their moving outwards. This mould is provided with an upper and lower heater holder in the usual way, and with a matrix; and in addition to these, there is a pair of forceps, so formed as to embrace the "movable tip," and to admit of putting in and removing the mould, or block, with the bonnet thereon.

The claim is limited to the movable parts of the mould, when used in combination with the forceps, and with the upper and lower heater holders, and the lower cup, or matrix.

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4. For an improved mode of connecting the *Elliptical Springs of Carriages;* Erastus T. Sprout, Dimock, Susquehanna Co., Pa., September 7.

The improvement in question, is for connecting together the elliptical springs of carriages on the front and back axles, by means of two horse-shoe springs; the open ends of the horse shoe springs being bolted to the upper and lower parts of the elliptic springs, and their curved or bow parts connected together by a screw swivel box and clevises, or clasps, so that the connexion between the two can be regulated by the screw swivel box to increase or decrease the tension of the springs, and thus prevent the longitudinal rocking of the carriage.

Claim.—"What I claim as my invention, is the combination of the two shoe springs, connected together by means of the swivel box and clevises, or clasps, and the elliptical springs, in the manner and for the purpose specified."

5. For an improvement in the apparatus for ***Heating Buildings with Hot Water;*** Benjamin Blaney, Boston, Mass., September 7.

This is for an improvement in the method of heating air for heating buildings, by the circulation of hot water through a series of tubes in a hot air chamber. The patentee says—"My apparatus consists in part, of a furnace and a vertical boiler. To the upper part of this boiler is attached a box, which I denominate a water trap, said water trap being intended to receive the water which by its ebullition is caused to flow into it from the boiler. From the bottom of the water trap, the heated water passes along and descends through a series of recurved pipes contained in an air-heating chamber, and from the lower part of these it again passes into the lower end of the boiler, and is thus kept constantly circulating while ever a fire is maintained in the furnace. The whole apparatus is to be contained within a suitable chamber, made perfectly close, excepting where provision is made for giving access to the furnace, and the opening or openings made for the admission of the air from without, which is to be heated, for the purpose of being conveyed through tubes into the apartments to be warmed."

Claim.—"What I claim therein as new, is the manner in which I have connected the boiler with the series of tubes or pipes, through which the heated water is to circulate, by combining therewith a box or vessel, such as that which I denominate a water trap, into which the boiling water is to pass, in consequence of its ebullition, and through which, as well as through the tubes connected therewith, and through the boiler, said water is to circulate for the purpose and substantially in the manner set forth."

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6. For improvements in the ***Brick Press;*** Collins B. Barker and E. Gifford, Troy, N. Y., September 7th.

This machine is double acting, that is to say, it is furnished with two moulds, and two pistons or followers, so arranged as to operate successively at each end of the machine, the bed of which is placed horizontally. There are two slides, moving in suitable guide pieces, one of which has a piston, and the other a mould, at each of its ends. These slides are moved back and forth by cams, placed upon a horizontal shaft which crosses the bed of the machine at its middle, and is made to revolve by any adequate power.

Claim.—"What I claim as new, is the manner in which we have arranged the moulds and pistons, or followers; the moulds and followers being affixed on either end of a slide, and said slides being moved back and forth, and the bricks pressed against a stationary plate or head, (at each end of the frame,) in the manner described, the whole arrangement being substantially such as is herein set forth."

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7. For improvements in the ***Steam Engine;*** Benjamin Crawford, Alleghany, Pa., September 7th.

Claim.—"What I claim, is the method of working the condenser of a Steam Engine, without the aid of an air pump, by so combining it with a valve which opens from an escape pipe into a water heater,

and with a foot valve which discharges into the open air, or into a reservoir of water—by which combination the steam which enters the condenser, escapes partly through the upper valve into the heater to heat the water for the boilers, and carrying with it a portion of the air from the condenser, and partly through the foot valve, carrying with it the water and air of the previous condensation; and when by these operations, the elastic force of the steam is reduced below the atmospheric pressure, the valves are closed, and the remaining steam condensed—all as described.

"I likewise claim the manner of preventing the water from flowing from one boiler into another, when the boat careens, by means of tubes, as described."

The condensation is effected by a jet of water introduced in the usual way. And the manner of preventing the water from flowing from one boiler to another, when the boat careens, is by forming the connexion between the two boilers by a tube, or tubes, which extends nearly to the off side of the two boilers, so that the careening of the boat carries that end of the tube which is in the upper boiler above the level of the water.

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8. For an improvement in the manufacture of *Salæratus;* Edward Chamberlin, Boston, Mass., September 7th.

Instead of suspending common pearl ash in distillers' or brewers' fermenting vats, to be carbonated under the process covered by this patent, it is suspended in a vessel through which the volatile products of the combustion of anthracite coal are passed, by connecting this chamber with a stove or other fire chamber, the pipe between the two being enlarged and provided with sieves to prevent the passage of fire and fire dust, or ashes, which are always found in the flues of fire places. Steam, from a steam boiler, is also, from time to time, introduced into the chamber containing the pearl ash.

Claim.—"What I claim consists in the employment and use of anthracite, *i. e.* its volatile products of combustion, in connexion with steam, without any purifying process of the volatile products of combustion, other than the separation of fine dust, as set forth, the whole being substantially in the manner and for the purpose specified."

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9. For improvements in machinery for *Combing Wool;* George E. Donisthorpe, Bradford, England, September 11, 1844, to run fourteen years from the 25th of November, 1843, the date of the patent in England.

In this machine the teeth on the main or carrying wheel project from the rim of a wheel in lines parallel with the shaft, as in machines previously known and used; and the teeth of the combs that act in connexion with these are made coarse at one end, and gradually finer towards the other, and the fine end is placed nearer to the carrying teeth on the wheel than the other; and the working combs have in addition to their rotary, a movement towards and from the carrying teeth; and the wool is applied to the carrying teeth, by means of feed

rollers, that not only cause the wool to advance, but also lash or lay it on to the teeth.

Claim.—"What I claim is arranging the teeth of the working combs at variable and decreasing distances apart, from one end of the comb to the other, as set forth (whether the said comb consists of a straight row of teeth, or several circular rows, or cylinders,) in combination with arranging the said teeth in such manner that as they increase in distance asunder, they shall increase in distance from the teeth of the carrying combs, or in other words, arranging the teeth of the working combs at increasing distances apart from each other, and from the carrying combs, as set forth.

Also, giving to each of the rotary working combs (when revolving and working with the teeth of the endless carrying combs,) a movement towards the common axis of the set of rotary working combs: the same being for the purpose specified.

Also, the manner of discharging wool from the teeth of the working combs, viz. by means of the sliding plates, &c., applied to the said teeth, and operated as set forth. Also, I do not claim the employment of one or more set of feed rollers for supplying the carrying combs with the fibrous material, but that which I do claim consists in the described manner of arranging and operating those feed rollers with respect to the carrying combs (or teeth thereof,) so as to cause them to lash, lay, or apply, the wool upon the said teeth, as specified, the said feed rollers and carrying teeth being arranged with respect to each other, and being operated, or depressed and elevated as described."

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10. For improvements in the *Argand Lamp;* Edwin B. Horn, Boston, Mass., September 11th.

We have here a patent granted for improvements in that class of Argand lamps in which the oil is forced up from a reservoir in the pedestal, to a fountain surrounding the burner, by a weight or other means of making pressure on the oil, in the reservoir below. The first of these improvements is for regulating the supply of oil to the fountain above, by means of a float provided with a valve which closes the aperture in the pipe through which the oil is forced from below, there being an air and oil passage between the fountain and the burner. And the second is for a device, fully expressed in the claim.

Claim.—"I shall claim the combination and arrangement of the burner and fountain, containing the float with the air and oil passage between them, substantially in the manner described. Also forming one or more openings through the inner side of the upper part of the fountain, for the escape of the air and surplus oil, in the manner, and for the purpose set forth."

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11. For an improvement in the *Rotary Steam Engine;* Edward Locke, Newport, England, September 11th.

The improvement in question is on an engine patented to J. J. Cordes and Edward Locke, on the 29th of March, 1841, and noticed

in the third series of this Journal, vol. iii, page 345, to which the reader is referred, to enable him to understand fully the following

Claim.—"I claim as my invention, the application of a separate steam cylinder, or engine, distinct from the main rotary engine, but which may be worked by steam from the boiler, for working the exhausting apparatus, by which the vacuum is kept sufficiently perfect in the case of the main revolving wheel, instead of depending on the revolution of the main revolving wheel itself, to work the exhausting apparatus for producing the required vacuum for it to revolve in."

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12. For a mode of adapting a *Circular Saw to a Scow or Vessel for Cutting piles under Water;* Erastus E. Cole, Boston, Mass., September 14th.

The journals of the saw shaft work in a frame which slides in ways attached to the scow, or vessel, and provided with a counter weight to balance the saw and sliding frame, so that the motions of the vessel occasioned by waves, &c. in harbors, shall not affect the operation of the saw.

Claim.—"I claim the sliding saw in combination with the scow, or other floating body, for the purpose as herein specified."

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13. For a machine for making *Sand, Glass, or Emery paper;* Edmund Morris, Philadelphia, Pa., September 14th.

The paper receives the glue from a rotary brush, that takes it from a distributing roller and vat, and then passes under another rotary brush which spreads it more equally; from this it passes under a sieve to receive the sand, glass, or emery, and then on its way to the roller on which it is rolled up, it is acted upon by the wings of a knocker, which throws off the surplus sand, &c.

Claim.—"What I claim is the combination of the knocker with the sieve, or other suitable apparatus, for distributing the sand, glass, emery or other suitable material, and with appropriate rollers and brushes, whether arranged precisely in the manner herein described, or in any other that is substantially the same, producing a like result by analogous means."

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14. For an improvement in the *Press for Cotton, Hay, &c.;* Wm. F. Provost, Barnwell District, South Carolina, September 14th.

The follower of this press acts upwards against the head block.—The pressing levers are jointed by their upper ends, to the under side of the follower, and by their lower ends to two rods called "swinging fulcra," which are jointed to the outer ends of the head block, or cap piece, of the press; and at the junction of the pressing levers and "swinging fulcra," there are rollers, around which ropes pass to draw the lower ends of the levers together, and thus force up the follower.

Claim.—"All I claim in the before described arrangement, is suspending the swinging fulcra of the pressing lever of the follower, to the head block, or cap, of the frame, against which the substance is pressed in the manner and for the purpose set forth."

15. For an improvement in *Reaction Water Wheels;* Roswell Cook, Elkland, Tioga county, Pa., September 4th.

Claim.—"What I claim is the peculiar construction of the buckets of the wheel, that is to say, starting from the top of the hub, at the circumference thereof, and diverging from it in a spiral manner to the middle of the bucket, from which point it gradually approaches the next succeeding bucket, till within such distance as is requisite to form a narrow issue descending from the upper edge of the bucket at an angle of about 45 degrees with the bottom thereof, to which it unites near the bottom of the next bucket."

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16. For an improvement in *Fish Nets;* John Carr, Jackson Shannon, and William Carr, Sunbury, Northampton county, Pa., Sept. 14th.

The Patentees say,—"The nature of our invention consists in dividing a cylindrical net into different compartments, and furnishing each with a bait bag, the bait being suited to the different kinds of fish, and the large fish being prevented from entering the compartments of the smaller ones."

Claim.—"What we claim as new, is the combination of a series of compartments in the manner and for the purpose described. We also claim the combination therewith of the bait bags, as specified."

The different compartments are separated by diaphrams of net work and funnels, the meshes in each succeeding one being smaller, so as to admit the kind of fish to be caught in the second compartment to pass through the first division, those to be caught in the third to pass through the second division, and so on.

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17. For improvements in the *Process of manufacturing Iron and Steel;* Thos. Southall and Charles Crudgington, Kidderminster, England, Sept. 14th.

Claim.—"We claim the introduction, into the melted iron, &c., of a compound of sulphur and a nitrate, either alone or combined, with either or all the ingredients enumerated in the foregoing description, as described, whether the proportions hereinbefore given be followed or changed."

The other ingredients with which the sulphur and nitre may be mixed, are borax, soda, or potash, and alum.

"The materials are broken into a small granular state, and equal parts, by weight, of sulphur, nitre, borax and alum, with half a part, by weight, of soda or potash, are to be well mixed together. These mixed matters are to be made up into parcels of about one and a half pounds each, that quantity being proper for treating about four hundred weight of pig iron, and in like proportion for any quantities of iron in the puddling furnace. These proportions are used when it is wished simply to improve the quality of the iron, but when it is desired to convert the iron into steel, then about four pounds or more of the mixture are required for each four hundred weight of iron."

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18. For an improvement in the method of *Cutting Raw Hide;* Wm. Marshall and John B. Thursby, Brooklyn, N. Y., Sept. 14th.

"The nature of this invention consists in the application of circular cutters or shears, in combination with guards and a traversing pin, made in such manner as to determine the width to be cut, and maintain a circular and lateral movement of the hide in its way towards the shears. The shears, by a circular movement, being brought to act upon and cut a strip from the outside edge of the hide of the requisite size for making rope, or for other use."

Claim.—"What we claim, is, first, the application of the circular shears, in combination with the guards, to regulate the hold which the cutters take upon the raw hide, as described; secondly, the application of the traversing pin as an axis for the circular sheet of raw hide to revolve upon, and to carry the hide, by a lateral movement, towards the shears, in combination with the shears and guards, as described."

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19. For an improvement in the mode of *Printing in Colors*, denominated the *Polychromatic Printing;* Thomas F. Adams, Philadelphia, Pa., Sept. 17th.

"The nature of this invention consists in combining several ink fountains together, so as to distribute ink therefrom on to the rollers that pass over the form in strips surrounding said rollers, so that the different lines of type will be inked with different colors."

Claim.—"What I claim, is the combination of a series of separate and complete inking fountains, constructed and arranged substantially as described, with a common inking apparatus, so as to impart to the ordinary inking roller various colored inks at one operation, in the manner and for the purpose set forth."

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20. For an improved *Basin or Platform*, to be used in connexion with a Dry Dock, for raising vessels and landing them on separate cradles on Railways; Rutherford Moody and Samuel D. Dakin, New York City, N. Y., Sept. 17th.

This is for an improvement on the mode of employing Floating Dry Docks patented by them on the 24th of November, 1843, and not yet noticed in this journal, which consists in providing a basin to receive the floating Dock when the vessel is floated up, and permit it to sink and rest on the bottom thereof, that the vessel may be drawn off, by means of a cradle, on to a railway on shore, so that the floating Dock may be used for raising any number of vessels and deposit them on the shore. The present patent is granted for the addition of a gate to this basin.

Claim.—"What we claim, is the employment of a turning, floating, or swinging, gate, or a gate of any other form, for the purpose of excluding water from the basin above described, to be used in combination with the said basin and the elevating or floating dry dock, above mentioned."

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21. For an improvement in the method of *Coating Iron or Copper with tin and with zinc, or other metal;* Edmund P. Moorewood,

England, Sept. 17th, 1844, to run fourteen years from the 4th of May, 1843, the date of the English Patent.

The metal to be coated, after being cleaned in the usual manner, receives the first coating of tin by deposit from a solution of a salt of tin, the metal to be coated being immersed in a vat containing the solution, and put in contact, above and below, with pieces of zinc.—This coating of tin is then covered with a second coating of zinc or other suitable metal, in the molten state. The machine for applying the second "consists of a pair of rollers, one above the other, together with what is called a back roller, which rollers are placed in a suitable frame, to sustain the gudgeons, or bearings. The back roller is used for the purpose of raising the sheets, or plates, out of the bath; but a bar of metal, or other device, may be made use of for this purpose. The pair of rollers are made to revolve in opposite directions, so that when a plate is introduced between the rollers it is carried forward by their revolution, and falling upon the back roller, which is placed above the level of the lower roller of the first named pair of rollers, and is situated as near as convenient to the pair of revolving rollers, is so far curved upwards that its end finds its way out at the surface of the molten metal," which is contained in a bath, the rollers being in the molten metal.

Claim.—"I claim the coating of sheets, or plates, or pieces, of iron, or of copper, by the combination of the two operations above described, in the manner above set forth, or any other substantially the same, whereby the sheets, or plates, or pieces, of iron, or of copper, are first coated with tin by precipitation, and then passed through a bath of molten metal, as above described, in order to give the second coating. I further claim as my invention and improvement, the machine or apparatus, for coating plates, or sheets, or pieces, of iron, or of copper, said apparatus or machine being constructed and arranged in the manner described, or in any other manner which is substantially the same. But as the processes of coating first by precipitation, and secondly by means of a bath of molten metal, may be combined and consecutively used, without the aid of the machine herein described, and as I believe this combined process to be substantially new, I claim said combination whether the second process be performed by the aid of the machine or by that of dipping in the ordinary way."

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22. For improvements in the *Permutation Lock;* Robert Newell, New York city, N. Y., September 17th.

The patentee says—"A main object of my improvements is to prevent the discovery of the position of the parts on which the security of the lock depends, either by the use of lights, or reflectors, introduced through the keyhole, or by an indication obtained by the lifting of the tumblers for the purpose of ascertaining the positions in which the followers and slides have been left by the operation of the key and bits at the time of the last locking. This I effect, in part, by the manner in which I have formed, arranged and combined a series of followers, slides, follower levers, and their appendages, and in part by the aid of what I have called guard plates, which form two distinct de-

partments or separate chambers in the lock, thereby cutting off all visible communication with the said followers, slides, follower levers, and other parts."

We are under the necessity of omitting the claim, as it refers to and wholly depends on the drawings.

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23. For a machine for *Cutting and Clearing Land of the Rattoon of Sugar Cane;* Norbert Lauve, Plaquemines, Louisiana, September 17.

The machine is made with two side pieces in the form of sleigh runners with handles like a cultivator at the back, and connected together, back and front, by two arch pieces; at the forward end there is a roller, and back of it two cutters, one following the other, with the cutting edges curved, and at the back there is a double edge cutter or cultivator, called in the claim a fluke, because of its resemblance (it is presumed,) to the fluke of an anchor. In the claim the first cutter is designated by the letter F and the second by the letter G. These cutters run on the surface of the ground, or a little below it, and are made adjustable by screw bolts.

Claim.—"What I claim is the manner in which I construct my rattoon cutter and plant cane scraper as described, that is to say, I claim attaching to the bottom of the two sled runners the curved knives F and G in the manner substantially as set forth; and in combination therewith I claim the fluke for clearing off the trash and dirt, constructed and arranged substantially as set forth. I also claim the combination of the roller with the above arrangement of knives, said roller being arranged in the manner and for the purpose set forth."

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24. For an improvement in *Coffee Boilers;* Daniel Rowland, Washington City, D. C., September 17.

This is for a mode of packing the joint formed by the union of a coffee pot and a condenser placed above, to condense the vapor rising from the coffee, and thus prevent its escape. The condenser is a cylindrical vessel containing water, and placed on the top of the coffee pot, by means of a flanch on the former, which slips over the latter. The lower edge of the flanch is turned in to hold a ring covered with cloth to form a packing.

Claim.—"What I claim is the mode herein set forth of securing the packing between the condenser and the coffee pot by means of the ring covered with cloth and the turned edge of the condenser by which it is fastened."

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25. For an improvement in *Block Letters, Numeral Figures, Ornamental Mouldings, &c.;* Lewis Katen, New York city, N. Y., September 20.

This improvement consists in making block letters, or numeral figures, mouldings, cornices, or other ornamental parts of buildings in detached frames of metal, wood, or composition, and fitting stained glass into the frames, or inclosing gold or silver leaf, tin foil, or other

coloring matter behind glass, or other transparent substance, in the said frame with cement, so as to be impervious to air or moisture,

Claim.—"What I claim as my invention, is the introduction into block letters, numeral figures, ornamental mouldings, cornices, and ornamental parts of buildings, of a coloring matter behind a plate of glass or other transparent substance in a manner which shall render it permanent and not liable to be tarnished by exposure to the air and moisture, in the manner set forth."

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26. For improvements in the machine for *Sticking Pins;* De Grasse Fowler, North Bradford, New Haven county, Connecticut, September 20.

The pins are delivered from a hopper on to the conductor, which consists of two pieces of metal (placed at such distance apart as to receive freely the shanks of the pins and not the heads,) which have an inclination in the direction of their length, and the delivery end is curved to deliver the pins horizontally into the grooved slide of the sticking machine. The upper edges of the two pieces are beveled for a small portion of their length, to form a gutter for the reception of the pins, and at the termination of the gutter they are beveled in the reverse direction to discharge the surplus pins into a gutter on each side to carry them off. This operation is facilitated by an angular piece of metal (designated in the claim by the letter *e*,) placed on the top of the conductor, which directs the surplus pins into the gutters.

Claim.—"What I claim as my invention, is—First—the combination of a sliding bed in which the grooves are cut for the reception of pins, with the stationary curved conductor, combined and arranged substantially in the manner and for the purpose set forth. Secondly—I claim the stationary conductors having two inclined bars with a downward curvature at the ends, as described, and in combination therewith the gutters on each side into which the surplus pins pass, and are carried off, the triangular piece *e* aiding in the operation.—In the above claim I wish it to be understood that I do not claim the inclined conductors when made straight, but only with the curved terminations."

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27. For improvements in *Balances;* James H. Ball and Richard H. Ball, New York city, N.Y., September 20.

The following claim indicates the improvements so clearly as to render explanatory remarks useless:

Claim.—"What I claim is, the combining of a spring balance with the various kinds of lever balances to which it may be adapted, for the purpose of rendering the weighing of merchandize more easy, certain, and expeditious; and this we claim whether the spring balance be used with or without our improvements upon it herein described; secondly, we claim in combination with the spring balance described the addition of a second hand. Thirdly—We claim the spring balance described, consisting of the modes of preventing the trembling motion of the hands, viz., the liquor cylinder and dasher."

28. For an improvement in *Cooking Stoves;* James Lewis, Amsterdam, Montgomery county, New York, September 20.

This improvement is for "forming a double flue around the oven, by which arrangement the heat is made to circulate twice around the oven instead of once, thereby causing the cooking operations of the oven to be performed with much less fuel than heretofore consumed, and more equally." The oven is below the fire place, and the draught passes from the fire chamber down the outside flue, along the bottom under flue, back again under the oven, up the same side that it descended, but in the inner flue; then between the top of the oven and bottom of the fire place, down the inner side flue, and up the outside flue on the same side to the pipe. There are dampers to carry the draught directly out if it is not desired to heat the oven.

Claim.—"What I claim, is making the stove with an additional flue around the oven in the manner and for the purpose set forth."

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29. For an improvement in *Horse Hames;* Joseph K. Slater, and Sylvester G. Pratt, Boston, Mass., September 20.

This is for an improvement on improved hames, patented by Nathan Post, on the 15th of June, 1844, and noticed in this volume, page 90, and to which the reader is referred. The improvement consists in extending each of the bearers or purchase bars, which spring from the middle of each hame downwards as far as the lower end of the hame, by an intervening connecting piece of metal; or instead of connecting them in such manner, the bearer may be made of sufficient length, and be bent at right angles, and fastened at its end to the end of the hame.

Claim.—"Having thus explained our improvement we shall claim the same, that is to say, connecting the lower ends of the hames and bearers substantially as set forth, and for the purposes set forth."

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30. For an improvement in *Cut-Off Valves in Steam Engines;* Barnabas H. Bartol, Cold Spring, Putnam county, New York, September 20.

The valves are those known as slide valves, the seat of the cut-off being above that of the steam valve, and the former is operated by an arm on the stem of the latter acting against stops on the stem of the cut-off valve, the stops being adjustable for the purpose of regulating the cut-off.

Claim.—"What I claim as constituting my invention, is the manner in which I have combined the action of the cut-off and steam valves, by means of the arm attached to the stem of the steam valve, and the movable or sliding cams or stops, made adjustable on the stem of the cut-off valve, for the purpose of regulating the cutting off of the steam, by the action of the respective parts as herein described and made known."

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31. For an improvement in *Ships' Sails;* Archibald Trail, Great Britain, September 24th, 1844, to run 14 years from the 24th of February 1844, the date of the English patent.

Claim.—"Having described the nature of my invention," says the patentee, "I would have it understood that I do not confine myself to the precise details described, and it will be evident that the directions of the strengthening cords, bands, or lines may be varied so long as the peculiar character of my invention be retained. But what I claim is the mode of manufacturing sails by applying strengthening cords, bands, or lines, crossing each other on opposite sides of the sails in such a manner as to support the canvas at intervals as described, and thereby giving additional strength to sails for ships and vessels."

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32. For an improvement in the machine for *Excavating Ditches;* Edwin Owen, Laporte, Louisiana, September 24.

To the forward part of the machine there is a triangular cutter lying horizontally for the purpose of clearing and cutting away bogs, brush, &c., and back of this shield, boards inclining backwards on each side from the beam, to carry the cut bogs, and brush, &c. beyond the surface to be ditched; back of these there are inclined cutters to form the sides of the ditch, which are attached at botton to the cutter which forms the bottom of the ditch, and then come the mould-boards in a wedge form, the angle forming a cutting edge inclining backwards from the beam to the cutter. The mould-boards carry up the earth beyond the sides of the ditch, by two curved conductors attached to beams placed above the mould-boards.

Claim.—"What I claim is, the combination of the triangular horizontal knife and shield in the manner and for the purpose set forth. Lastly, I claim the combination of the conductors with the mould-boards in the manner and for the purpose specified, said mould-board being made to slant under at its front edge to facilitate its clearing."

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33. For an apparatus for *Preserving Fruits and Vegetables by means of Ice;* Peter Kephart, Uniontown, Carroll county, Maryland, September 24.

The preservation of fruit or vegetables is to be effected by placing them in a chamber surrounded by ice, or water nearly at the freezing point, the apparatus being so contrived as to admit of changing the ice or water. The whole design being predicated on the fact that vegetables and fruits can be preserved for a great length of time in a perfect state by keeping them at a temperature near the freezing point without freezing.

The ice is deposited on the top of the compartment for fruit, &c., and the water therefrom circulates around the sides and bottom. And there are also tubes surrounding this compartment through which water of a higher temperature can be passed to moderate the temperature should there be any danger of freezing.

Claim.—"What I claim is the so constructing of said apparatus, in the manner described, as that the substances contained in the preserving compartment may be subjected to the influence of the ice deposited on the covering, in conjunction with that of ice cold water produced by its melting; or to the additional influence of a thin stratum of

ice surrounding the sides of said compartment; or to the moderated temperature produced by the supplying of water to the tubes or troughs; the respective parts being combined, arranged, and operating substantially as set forth."

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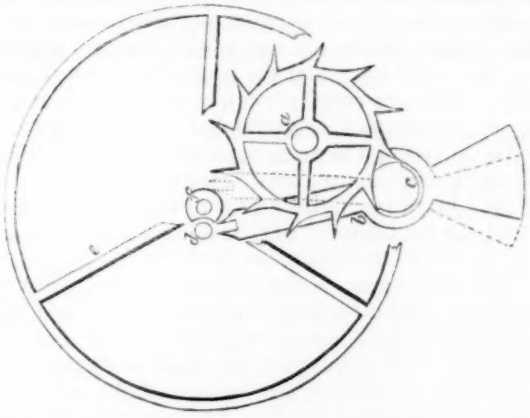
34. For an improvement in *Escapements of Chronometers, Watches, Clocks, &c.;* Oramel W. Waste, Pittsford, Monroe county, New York, September 24.

"The nature of my invention," says the patentee, "consists in applying detents, or a detent cylinder, to the lever as it is used with the roller and jewel pin in the lever watches now in use, and placing the staff of the balance in such a position with the scape wheel, so that by its teeth being locked and unlocked in a peculiar manner, the balance may receive its impulse directly from the teeth of the scape wheel, as in the chronometer and duplex watches, without being subject to many of its disadvantages."

The accompanying diagram will convey to the mind of the reader a much better idea of the arrangement than a lengthy description.



Claim.—"What I claim, is the application of detents, or a detent cylinder, to the lever as it is used with the roller and jewel pin in the lever watches now in use, also the manner of constructing my detent cylinder, as described, also the arrangement attained in the use of the detents or detent cylinder as combined with the lever, as described, together with the placing of each of the three axles of this escapement so that, by their relative position with each other, they shall produce in connexion with the detents or detent cylinder, the above described locking and unlocking of the teeth of the scape wheel, so that the balance shall receive its impulse on the jewel pin at the time the tooth shall pass the whole distance from one detent to the other, it being $\frac{9}{10}$ths or a greater part of the distance from the point of one tooth to the point of the next, and shall pass the remaining tenth or

lesser distance as it is unlocked by the balance returning, as described. And I also claim the right of applying my escapement in the construction of chronometers, watches, clocks, and such other instruments or machines to which it may be advantageously applied."

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35. For an improvement in *Trusses for Hernia;* Charles C. Reinhardt, and Valentine Carter, Baltimore, Maryland, September 24.

The pad is so connected with a spring lever, projecting downwards from the main spring, to which it is jointed, as to have a free movement thereon.

Claim.—"What I claim is, combining the pad having a motion on its own axis with the main spring of the truss by means of the jointed lever, the construction, arrangement, and operation of the whole being substantially as specified."

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36. For an improvement in the *Chair for Invalids*, called the "*Therapeutic Chair;*" James G. Holmes, Charleston, South Carolina, September 24.

The patentee says—"The principal characteristic feature of my chair is the peculiar manner in which I have combined the seat with the back, with a jointed apron in front, and with the lower frame of the chair, so that a person sitting therein, can by his own weight operating on the back, cause the back and the apron to assume a horizontal position, and to constitute a couch; or can cause the back and the apron to stand at any inclination to the bottom that may be desired; and can also, by allowing his weight to press upon the seat, elevate the back, and depress the apron at pleasure, from a horizontal or inclined position.

The back is jointed to the back part of the frame, and the apron to the front, and the seat instead of resting on the frame is jointed to the back and apron above their junction with the frame.

Claim.—"What I claim, is the manner in which I have combined the seat, the back, and the apron with each other, and with the lower segment or legs of the chair, as set forth, by which combination and arrangement the person occupying the chair is enabled by the action of his own gravity, to govern the position of the moving parts; the whole being connected and combined substantially as described."

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37. For an improvement in the manner of *Making Bricks;* William T. Peters, Executor of Ithiel Town, New Haven, Connecticut, September 27.

This "consists in making the bricks hollow with partitions connecting the sides and ends.

Claim.—"What I claim, is the method of constructing bricks of the forms described, in the manner and for the purpose set forth, having the interior hollow and intersected with partitions, as described."

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38. For an improvement in the *Reaction Water Wheel;* Theodore R. Limby, Cato, Cayuga county, New York, September 27.

The claim will convey to the reader as distinct a notion of the construction of this wheel as could be given without drawings.

Claim.—"What I claim, is the peculiar spiral form which I give to the channels of said wheel, from their upper ends to their delivery openings, such openings being, in all cases, substantially the same with that made known. I likewise claim the lessening of the delivery openings by means of gauge plates, whether effected in the manner set forth, or in any other that is substantially the same.

The gauge plates are attached to the wheel at right angles to the delivery, in such a manner that the size of the delivery can be contracted and enlarged at pleasure.

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39. For an improvement in the *Churn;* A. C. Stiles, South Bloomfield, Pickaway county, Ohio, September 27.

The box of the churn is divided into two chambers by a perforated partition, and in each of these there is a dasher, the stem or rod of which is jointed to an arm from a rocking shaft at each end of the box, and the two rocking shafts are connected together and to a hand lever by a connecting rod jointed to a pendulous arm at the end of each rocking shaft and to the hand lever placed mid-way between the two. The arms are so connected that when one dasher rises, the other descends. The box is placed on rockers, so that by the operation of working the dashers by the hand lever, the box is rocked and thus the cream is acted upon by the dashers and forced through the holes of the partition by the combined action of the dashers and the rocking of the box.

Claim.—"What I claim is the combination of the rockers and dashers in the double chambered churn, and for the purpose set forth."

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40. For an improvement in *Telegraphic Communication*, denominated the *American Semaphore;* Henry J. Rogers, Baltimore, Maryland, September 27.

This invention "consists in the combination of a series of balls, disks or lamps, a row of which are placed in a line, which it is preferred should be vertical, as numerators, and moving other balls in lines parallel therewith that are decimally arranged for denominators by means of chains or other analogous contrivances for land or sea service. Or for sea service alone signal flags may be used.

Claim.—"What I claim is,—First—the combination and arrangement of signal disks or lanterns, in the manner and for the purpose set forth. Secondly—I claim the method of signalizing the alphabet by means of a decimal progression. Thirdly—the system of flags described, that is to say, the combination of numeral and decimal or denominator flags, combined and applied in the manner specified."

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41. For an improvement in the *Ring Groove Spinner;* John Thorp, North Wrentham, Norfolk county, Massachusetts, September 27.

This is for an improvement on the well known ring groove spinner, patented many years ago by Mr. Thorp, and consists of a ring made of round wire let into a hole made in a plate of iron; on this ring is fitted the wire hook which is carried around with the thread in spin-

ning, and for the purpose of putting this hook on the ring a small hole is made in the plate by the side of the ring, and a portion of the outer periphery of the ring, the hole being somewhat larger than the diameter of the wire of which the hook is made.

Claim.—"What I claim, and desire to secure by letters patent, is an improvement consisting of a new combination of ring, hole, and hook, adjusted to the plate of the ring flyer, and in combination with each other, the ring, hole, and hook, forming, by the peculiar construction and adjustment of each, and by their combination as in the specification, an improvement of the ring flyer, and which is called the universal ring flyer."

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42. For an improvement in the *Bark Mill, for Grinding Tanners' Bark;* Mather Beecher, Remson, Oneida county, New York, September 27.

In this mill the concentric rings of the runner work between those of the fixed or bed grinder; the teeth being formed on the inner and outer peripheries of the rings, and the upper edges armed with cutters, to cut the bark into large pieces before the grinders begin to act.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the addition of the hook extending above the edges of the rings of the grinder, and presenting their point forward in the direction of the motion of the grinder. The whole being arranged, constructed, and combined substantially as described."

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43. For improvements in machinery for *Pulverizing Clay and making Bricks;* Nathan Sawyer, Baltimore, Md., September 27.

The clay is pulverized by means of a vertical wheel with the two faces armed with circular rows of teeth; the sides of the box (called cheeks) below the shaft are also provided with corresponding teeth, and at the top of this box there are bars or rods of iron, bent in semicircles, so arranged as to lie between the rows of teeth on the wheel; these are called "guard pieces," and prevent the entrance of stones.

The pulverized clay passes from the pulverizer into a trunk of considerable length, into which a follower works, to force the clay forward to a cutting knife; the condensation of the clay being effected by the resistance occasioned by the sides of the box, which, at the same time forms the ends and sides of the brick, the thickness being formed by a knife which moves up and down, and which, at each stroke, severs a brick from the block or mass of compressed clay forced through the trunk. The trunk is made larger at that end in which the follower works than it is where the bricks are formed, and the intermediate space slopes regularly to condense the clay. To a sliding gate, immediately in front of the end of the trunk, there are two knives attached, one to pare off the end of the mass of clay to form one face of the brick, and the other to sever or separate the brick from the mass.

Claim.—"What I claim is the manner of condensing the pulverized earth or clay, by forcing it by means of a piston, through a channel like that which I have denominated a moulding trunk, which trunk may be made to vary in the dimensions of its respective parts, in the

manner set forth, or may be of the same dimensions throughout, but of increased length; it being so made, in either case, as that the friction of the clay against the sides of the channel along which it must pass, shall suffice to cause the material to be sufficiently condensed to give the required solidity to the brick.

"I likewise claim the cutting off and paring the sides of the brick by means of knives, arranged and operating substantially as set forth. I also claim the particular manner of constructing the pulverizer, by combining a revolving disk, furnished with teeth on each of its faces, with the guard bars and the cheeks, as set forth."

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44. For an improvement in the *Hand Printing Press;* Seth Adams, Boston, Mass., September 27.

The following claim is deemed sufficient to enable the reader to understand the character of the improvement.

Claim.—"I claim my particular mode of arranging and operating the bed, (with or without its form of type) platen, frisket frame, (with or without its frisket) and inking apparatus, with respect to each other; not meaning in the above to claim the mechanical devices adapted to produce their respective movements, but the manner in which they are all arranged and operate together, or in combination with each other, the said arrangement and operation of the parts consisting, first, in placing the platen in line between the bed and frisket frame, (when the frisket frame is out or in the position to receive a sheet of paper to be printed) and somewhat above the same; secondly, in causing the bed and frisket frame to be moved towards each other and the platen and beneath the platen, and so as to carry the frisket (containing the sheet of paper) directly under the platen and over the form of type on the bed—and, after imprinting the sheet of paper, reversing the movement of the bed and frisket frame, so as to cause them to recede from each other and the platen, and to come in their first position, viz:—such a position as will enable the operative or operatives of the press to remove the printed sheet of paper and supply its place with one to be printed; and thirdly, in disposing the inking apparatus directly in rear of, or upon the rear part of the platen, and so that as the bed passes out from beneath the platen, and in or below the same, the said inking apparatus shall ink the form of type, as set forth.

"I also claim the combination of levers, connecting rods and links in their application to the bed and frisket frame, in the manner as set forth, and for the purpose of producing the required movements of the frisket frame through those of the frame. I also claim the manner by which I am enabled to produce the reciprocating, rectilinear, lateral movements of the distributors upon the roller beneath them, without using any apparatus such as is generally applied to the said lateral distributors for changing their angular positions with respect to the roller beneath them, so as to cause them to travel upon it from one end of it to the other end, in an opposite direction, viz: by arranging the main distributing rollers with respect to the roller by which the type is inked, and the said inking roller with respect to the bed, as de-

scribed; the peculiar back and forth motions of the lateral distributors from end to end of the roller—which has never been so effected in any printing machine which has ever come to my knowledge."

Patent Re-issued in the month of September, 1844.

1. For an improvement in the mode of *supplying Steam Boilers, and in the manner of operating the valves of Steam Engines;* Henry R. Worthington, New York City, September 7.

This patent was originally granted on the 24th of July, 1844, and noticed in this journal, vol. ix, third series, page 178, to which the reader is referred for a description of the apparatus.

Claim.—"What I claim, is the employment of a spring in combination with the steam valve of an auxiliary engine, for supplying a boiler with water, so arranged, substantially as described, as to admit of its being properly armed or compressed by the action of the engine upon an intermediate piece, or lever, while the steam valve remains at rest, until, at the proper time, by the farther motion of the engine, the spring is released, and also to draw said valve independently of the momentum of the engine, in the manner and for the purpose above fully set forth."

List of American Patents which issued in the month of November, 1841, *with Remarks and Exemplifications. By* CHARLES M. KELLER, *Examiner of Patents.*

(Continued from Page 258.)

24. For a machine for *Cutting Crackers;* William R. Nevins, New York city, New York, November 10.

The cutters are attached to the faces of a rotating polygon. The dough is rolled between two rollers and then passes between the lower of these two rollers and the cutters which form the crackers that are carried around and deposited on an endless belt, by means of a follower in each mould which forces the crackers out, this is effected by bolts to which the followers are attached, and which are surrounded by spiral and bow springs to keep the follower drawn in against the bottom of the mould until they come around to that part of the circuit at which the crackers are to be discharged, at which time the heads of the bolts are brought against springs projecting in manner similar to cams from a cylinder within the polygon of cutters.

Claim.—"What I claim is,—First—the arrangement of the cutters on a polygonal drum; Second—the spiral springs in combination with the bolts, and the manner in which they are intercepted by the springs; the whole combined substantially as set forth."

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25. For an improvement in the *Pump;* Joel Farnham, Stillwater, Saratoga county, New York, November 10.

Claim.—"What I claim, is the before described construction of the

box bolted to the bottom of the cylinder, and side trunk and cap, for simplifying and reducing the expense of the pump and its liability to get out of order, as set forth—that is to say, making a single solid cast iron box, divided into three chambers by a transverse partition, forming a receiving chamber, and a longitudinal partition extending from said transverse partition to one end of the box forming the two discharging chambers having the top perforated with six apertures, two over the first mentioned chamber, and two over each of the other chambers, and having the bottom perforated with a single aperture leading to the receiving chamber for the admission of the water to the said chamber, doing away with the lower or under cups, and valve, plates and valves, and the necessary packing, and bolts for securing the same, in the manner and for the purpose set forth."

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26. For an improvement in the machine for *Cutting Shingles:* Lloyd White, Jeffersonville, Clarke county, Indiana, November 10.

"I am aware," says the patentee, "that shingle machines have been made with two knives so arranged as to approach each other in shaving the shingle from the butt to the point, but in such cases the block moves up towards the knives, which have no other motion than towards each other while the taper is being formed, and therefore I do not wish to be understood as making claim to the employment of two knives that approach each other in cutting from the butt towards the point. But what I do claim as my invention and desire to secure by letters patent, is the combination of the two plates, or gates, with the knives attached to them and working in slides which approach each other towards the bottom, for the purpose and in the manner described."

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27. For an improvement in the construction of *Bridges;* Josiah Rogers, New York city, New York, November 10.

Claim.—"What I claim, is the constructing of a cylindrical bridge, either of wood, or iron, by the combining together of circular ribs, string pieces, and diagonal braces, which braces consist of continuous strips of wood, or of iron, surrounding the ribs and string pieces, and passing spirally in reversed directions from end to end of the bridge, thus constituting a braced lattice work on the exterior of the cylinder. The whole being constructed, arranged, and combined substantially in the manner set forth.

"I also claim, in combination with such a cylinder bridge, the forming of a rectangular passage way, having its vertical sides, or a vertical partition, constructed, arranged, and combined substantially as made known."

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28. For an improvement in the *Tuyere for Blacksmiths' Forges;* Joseph Lauback, Middletown, Dauphin county, Pennsylvania, November 10.

A vertical hollow cylinder with a basined rim at the top and a valve at the bottom, is let into the hearth, the basined part at top being

made to receive the coals, and the valve at the bottom for the discharge of the cinders which may fall through. Instead of a grate for the hearth, there is a triangular piece of cast iron on a shaft placed in the upper part of the cylinder, the shaft being provided with a crank handle for turning or vibrating it, and the edges notched for the passage of the blast from a bellows, the nozzle of which is introduced near the bottom of the cylinder.

Claim.—"What I claim, is constructing the blacksmith's forge with a revolving or vibrating hearth in the manner and for the purpose set forth, and in combination therewith the cylinder with the basined rim forming part of the hearth and having a tube to receive the nozzle of the bellows, said cylinder receiving the blast from the bellows, and serving as a receiver for the small cinders, as described."

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29. For an improvement in *Water Backs for Forges;* William McEwen, Norristown, Montgomery county, Pennsylvania, November 10.

The improvement "consists in so constructing it that the cast iron box, or tank, which contains the water, and the fire end of which constitutes the forge back, shall project into the body of the forge to a distance beyond the wall, or stack, which constitutes the brick work, or masonry thereof, so that the blast shall issue from the nozzle, or tuyere, in advance of the ordinary forge back; by which improvement it is specially adapted to the heating of wide bars or other large masses of iron."

Claim.—"What I claim, is the forming of the box, or tank, with a projection, or offset, so as to cause the blast from the bellows to escape from the nozzle, or tuyere, in advance of the line of the ordinary forge back, in the manner and for the purpose set forth."

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30. For an improvement in *Suction, Lifting, and Force Pumps;* Chapman Warner, Lexington, Fayette county, Kentucky, November 10.

This "consists in combining two vertical cylinders of unequal diameters, the smaller one arranged above the larger one, at a short distance therefrom, leaving their axes coincident with an air chamber of greater diameter than the lower cylinder, formed on the upper end of said lower cylinder and surrounding the upper cylinder, whose flanch forms the top thereof, covering the space between the outside small cylinder, and the inside of the air cylinder with a spout passing down through said flanch to near the bottom of the air chamber, having two pistons on a single piston rod, moved by a connecting rod and lever, one of which pistons is solid and moves in the upper, or small, cylinder, for forcing, and the other, which works in the lower, or large, cylinder, is perforated for the passage of the water through the same, is for lifting the water, and also for forming a vacuum in the larger cylinder into which the water rises through a lower valve on the bottom of said large cylinder, and also at the top of the pipe leading to the well of water."

Claim.—"What I claim, is the manner of combining the two cylinders of unequal size with an air chamber having a spout so as to produce, by means of two pistons, arranged as set forth, an equal discharge of water at the upward and downward stroke, or nearly so, substantially as described."

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31. For a *Pressure closing Stop Cock for Conduit Pipes;* Horatio Allen, New York, November 12.

A chamber is formed in the pipe, "of dimensions proportionate to the area of passage which the cock is to provide; on the inner surface of this chamber is a projection, or shoulder, of a depth sufficient to afford an adequate lap and seat to the valve which is to close against it." The plate which is to close against it is jointed to an arm projecting from a shaft which passes to the outside of the pipe or chamber, and there provided with a hand lever for opening or closing the valve, and this lever is acted upon by a spring to assist in opening or closing the valve and retaining it in place. By this arrangement the valve is kept to its seat by the pressure of the water acting against it.

Claim.—"What I claim, is, first, the combination of a suitable seat, formed in the inside of a pipe or of a chamber to be placed in the line of the pipe, with a plate or valve closing with the pressure against said seat, the plate or valve being carried by an arm attached to a shaft which is worked by a handle outside the chamber; secondly, the combination of a spring with the handle outside the chamber, either acting with the pressure of the contained fluid to close the valve when the pressure is very light, or acting against the pressure if the contained fluid is very great."

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32. For an improvement in *Spectacles;* Christopher H. Smith, Niagara Falls, Niagara county, N. Y., November 12.

The bows of these spectacles are without glasses, and to the main frame are attached, by swivel joints, two sets of different kinds of glasses; either or both of which can be brought to cover the open apertures or bows, and by means of the swivel joint, the glasses can be turned so as to have either set let into the bows, and the other at the sides or over them, and thus the colors or focal powers may be changed at pleasure.

Claim.—"What I claim as my invention, is combining the glasses with each other and with the main frame, by means of the hinge and swivel joint arrangement described, which admits of the glasses being changed, and at the same time adapted to the vacant apertures, all as set forth."

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33. For an improvement in the manner of *arranging the screw, or spiral, propeller for Steam Ships or other vessels;* Francis Pettit Smith, London, England, November 12, to run fourteen years from the 31st of May, 1836, the date of the English patent.

Claim.—"What I claim as my invention, is the arranging, or placing, of a screw propeller in the dead wood, or dead rising, of a vessel,

the thread of which screw shall make one entire revolution, or nearly so, upon its shaft, which thread may be in one continuous piece, or it may be divided into two parts, each making one half turn, or revolution, round the shaft, or be otherwise modified whilst it is made to operate in the dead wood substantially in the manner fully made known."

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34. For improvements in the *Cooking Range;* Abiram Spaulding, New York City, November 12.

We are under the necessity of omitting the claim, as it refers throughout to, and is wholly dependent upon, the drawings, which are very numerous, and necessary to a clear exemplification of the improvements claimed.

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35. For a *combined Dumb and Parlor Stove;* Alonzo L. Blanchard, Albany, N. Y., November 12.

The leading characteristic of this stove is fully expressed in the following

Claim.—"What I claim, is the manner of combining with each other, a statue or other ornamental device, and a pedestal, divided into compartments, substantially in the manner set forth, so that they shall constitute a dumb stove, within which the heated air from a fire below shall circulate through the respective chambers, and through the body of the statue or other ornamental device placed upon the pedestal, as set forth. I claim, also, the combining with such a stove, a fire chamber, by means of which it may be converted into a parlor stove; said combination being formed by arranging the respective openings, chambers, and dampers, substantially in the manner made known. I claim, likewise, the particular manner of hanging the door of my parlor stove with concealed hinges, as described. And lastly, I claim the manner of supplying the draught to the fire chamber through a trunk, or hollow case, located and arranged as described."

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36. For an improved *apparatus for making Bedsteads;* Thos. Cole, Greensburg, Decatur county, Ia., November 12.

This apparatus consists of a box, into which, the rails of bedsteads are secured and held by wedges and screws, and provided with guides for directing the saws in cutting the tenons, and the bits in boring the holes, without shifting the rails.

"What I claim is the particular manner of combining and arranging the respective parts of the box for receiving the rails, and for cutting the tenons thereon, and for boring the requisite holes therein, without shifting said rails during the operation; the whole being constructed and operated substantially as set forth."

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37. For an *open Grate or Parlor Stove for Anthracite Coal;* Otis Jenks, Albany, N. Y., November 16.

The claim in this patent refers throughout to the drawings, and without them, a clear notion of the structure and arrangement could not be given; and as, from their complexity, their insertion would

carry us beyond our limits, we are under the necessity of omitting all farther notice.

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38. For an improvement in the *Lamp for burning Lard and other concrete fatty matter;* Norman S. Cate, Charlestown, Mass., and James H. Putnam, Malden, Mass., November 16.

The burner of this lamp consists of two flat wick tubes, with a metallic conductor between them, and held in a spring clasp, and provided with teeth or cogs on one edge, into which, the teeth of a pinion take, to move it up and down, and thus regulate its position relatively to the height of the wicks.

Claim.—"I shall claim the movable metallic conductor situated between the wick tubes, and arranged in the spring collar, as described, so as to be elevated or depressed, or adjusted to any desirable position with respect to the flame; the same being constructed and operating substantially in the manner set forth."

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39. For an improvement in the *Life Preserver;* Napoleon Edward Guerin, New York City, November 16.

Claim.—"What I claim as my invention, is the introduction of rasped or grated cork into any garment, as a life preserver."

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40. For an improvement in *Elliptical Carriage Springs;* David E. Edwards, Boston, Mass., November 16.

Claim.—"I shall not confine myself to the method described of confining the ends of the plates, but I claim as novel and of my invention, inserting between the main lower and upper plates of an elliptic spring, a double curved spring, or one forged into the shape of an oge curve, or approaching to that of the letter S, so as to divide it into two springs and increase its rigidity, at the same time superseding the use of most, if not all the ordinary back plates; the whole being substantially as above described."

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41. For a mode of *securing Metallic Shanks in Glass Knobs;* John G. Hotchkiss, J. A. Davenport and John W. Quincy, New York City, November 16.

"In forming the knobs of glass, whether by blowing or by pressure, a cavity is left in the back part of the knob where the neck, shank, or screw is to be fastened; such cavity being so made as that by means of a fusible metal or alloy, poured into it, the neck, shank, screw, or other article prepared for the purpose, shall be securely held in place."

Claim.—"What we claim, is the securing of shanks, screws, &c., within knobs of glass, by means of a fusible metal or alloy, substantially in the manner made known."

BIBLIOGRAPHICAL NOTICE.

American Quarterly Journal of Agriculture and Science; conducted by Dr. E. Emmons and Dr. A. J. Prime. Albany, New York: Price, $3 per annum.

Among the novelties of the day, we find upon our table, the first number of a new quarterly Journal intended to be principally devoted to the interests of Agriculture, under the title "American Quarterly Journal of Agriculture and Science; conducted by Dr. E. Emmons and Dr. A. J. Prime, Albany."

Heartily do we rejoice in the appearance of this new journal and earnestly do we desire to see it as eminently successful as it deserves, believing, as we do, that to no country has Providence given greater facilities for agricultural improvements and no where have these advantages been more entirely neglected or abused. We think, however, that we have been able, of late, to see the awakening effects of the numerous journals which have already devoted themselves to this subject—and we hail the appearance of a new and powerful auxiliary in this indispensable improvement. The number now before us, gives great promise of an unusually high degree of excellence; its principles, as announced in the address to the public, must, if adhered to, render it of inestimable value to our farmers; and we are peculiarly gratified to find the distinction at once drawn between the cropping fitted for our soil and climate and that suited to the vastly different circumstances which occur in Europe. The original articles are of interest, as well to the man who wishes to keep up with the progress of information as to the practical farmer. The chemical investigations of our American plants, we look upon as of very great importance, and hope that the journal may be made a medium for giving to the public similar analyses of our own soils by our own chemists. The foreign selections are judicious. In fine, we regard the appearance of this journal as of vast importance to our Agricultural interests, and hope that it will be encouraged as it should be, by our farmers throughout the country. Com. Pub.

MECHANICS, PHYSICS, AND CHEMISTRY.

On a Theoretical Rule for the Compression of Water, By Daniel MacKain, M. Inst. C. E.

[Read before the Glasgow Philosophical Society.]

The extreme elasticity of air, when considered with reference both to the amount of force which we can apply to it, capable of producing important changes in its volume, without any great effort, and to the strength of the materials of which the instruments used for ascertaining its compressibility, are composed, have enabled philoso-

phers to determine with considerable accuracy the ratio which it obtains between the force applied and the resulting condensation of volume.

A considerable time ago it was believed that the compressibility of air was in proportion to the pressure applied; this was subsequently proved nearly 200 years ago, by Boyle, and also by Mariotte about 50 years afterwards; and this law of compression has since been known by the name of the latter. More recently Messrs. Dulong and Arago have confirmed the accuracy of the law of Mariotte, by experiments conducted to the range of no less than 27 atmospheres beyond the common atmospheric pressure. *

By means of the barometer, the density of air is found to vary according to its mass superincumbent over any given point in the atmosphere, and the numerous experiments made with this instrument, have brought to such a degree of accuracy the barometrical measurements of parts of the earth's surface protruding into the air, as to vie with measurements of their heights made by trigonometrical instruments. These degrees of density are measured by a column of mercury, and, consequently, the height of the column indicates the force of compression, and represents the height of the superincumbent mass of air.

The extent of compression which water undergoes, when subjected to force has engaged the attention of men of science for some time back. In 1762, Mr. Canton found that the addition to, or subtraction from water, of a weight equivalent to that of the atmosphere, produced at the temperature of 60° a contraction or extension of rain water of 4 millionth † part of its bulk, and of sea water at 40 millionth parts, while in mercury it only amounted to 3 millionth parts: showing that the density of the fluid operated on materially affected the results. Thus, in the case of rain water, a force equal to a column of itself 33⅓ feet in height produced a contraction of 46 millionth parts: of sea water, a column 32 feet in height produced a contraction of 40 millionth parts: and in mercury, a corresponding column of 2½ feet produced 3 millionth parts of compression. Professor Zimmerman of Brunswick, Professor Œrsted of Copenhagen, the late Sir John Leslie of Edinburgh, and Mr. Perkins, have made numerous experiments that establish the fact of compression ascertained by Mr. Canton, which, at the time his experiments were published, was at variance with the opinions universally entertained on this subject. With the usual haste with which Sir John Leslie speculated on experimental results, he arrived at the conclusion "that the ocean may rest on a subaqueous bed of air," from the apparently greater degree of condensation which force can produce in air, in contrast with that which similar forces were supposed capable of producing on water.

The degree of compression of water, is, however, extremely small:

* This law has been recently extended by M. Aime to a pressure of 220 atmospheres. The full account of his beautiful and ingenious experiments will be found in Annales de Chimie, 3d series, tom. VIII, (1843) page 257.

It is evident that the author of the present article is unaware of these experiments, as well as the previous ones of Sturm and Colladom.—Com. Pub.

† For 4 millionth, read 46 millionth.

and the force which it is necessary to apply to it, in order to produce any appreciable degree of diminution in volume, is so great in proportion to the limit of rigidity of the materials used in experimental apparatus, that there is much room for doubt, as to whether or not the indications heretofore recorded, be not compound measures of the elasticity of water, and of the materials of which the instruments have been formed.

It has occurred to me, that if the results of the experiments were noted, in which great bulks of water were employed, but operated upon by slight forces, that a degree of compression might be ascertained, sufficient to remove much of the doubt that may at present be entertained as to the rigid accuracy of the experiments on which our ideas of the elasticity of water are at present based—further, that, in these experiments, should any analogy be discovered between the ascertained laws which govern the compression of air, and the comparative indications of compression of water, we may take the laws which repeated experiments have proved to govern the compression of air, as analogous rules for the compression of water; and, calculating from them, may compare the theoretical results which the laws would furnish, with similar conditions ascertained by experiment.

Following out this idea, it appears probable that the transmission of water and gas through long ranges of pipes, may, by the comparative forces required to propel given quantities through them, give an approximate rule for estimating their compressibility; for, if water were totally incompressible, there would undoubtedly be some difference between the quantities of air or gas transmitted through a pipe, and that of water by a corresponding force through a similar pipe—the one would accumulate in density according to the force required for its propulsion; while the movement of the other would be like a bar of iron, influenced only by friction.

In the transmission of water through long ranges of pipes, it has been ascertained that the quantity discharged by a pipe of any given diameter in length, is inversely in proportion to the square root of the length—and directly proportional to the square root of the height of the column of water employed to propel it.

The comparatively recent adaptation of carburetted hydrogen gas, for the purpose of lighting towns, has required attention to the laws by which it is conveyed through pipes. Gas is usually forced through pipes, by employing a slight column of water, of a height sufficient to propel the required volume with the velocity required. Now, as already mentioned, the laws of compression of gases and air *have been exactly ascertained;* and it is thence evident, that even the slight compressing force usually employed for the transmission of gas, must produce an alteration in its bulk, at the place where the motion originates.

The most exact observations made as to the laws by which gas is conveyed through pipes, show that in like manner as water, the quantity which a pipe can discharge, is inversely proportional to the square root of the length of the pipe, and directly proportional to the square root of the force employed to propel it. As gas, after having

been propelled through a range of pipe, and when escaping from its extremity into the air, will be only of the density due to the pressure of the atmosphere, the proportion of it at the origin of the pipe, or, as is usual in practice, that in the gas-holder, is not only of the density of the atmosphere, but is also of that further degree of compression due to the force applied for its propulsion through the pipes. In all experiments made with pressure-gauges along various lengths of pipes, this extra degree of compression is found to diminish according to the square root of the length of the pipe, thus showing a gradual relaxation of compression, and a steady progression of current.

The ascertained laws of impulsion and of retardation of gas and water being thus exactly alike, it now only remains to ascertain their measure; and if these be found proportional to their density, there appears reason to believe, that water, under proportional forces, is as compressible as air.

I shall endeavour to support these views by the following facts and deduction from them:—

As water is 825 times heavier than air, the velocity communicable to air contained in a pipe by the pressure of one vertical inch of water is equal to that of 825 vertical inches, or 68 feet of air; and if gases be referred to, as their specific gravity is usually compared with that of air as 1, the height of a corresponding column of any gas equal to 68 feet divided by the specific gravity of that gas; thus, one inch of water is equal to $\frac{68}{5.60} = 12$ feet of gas, specific gravity .560.

In the Hydrodynamie * of Bossut, he states as the result of experiment, that an aperture of one inch in diameter, under the pressure of a column of water 10 feet in height, discharged 8574 cubic inches, or 4.96 cubic feet of water per minute.

By an experiment made at the Leith Gas Works, a hole, one inch in diameter, under the pressure of one vertical inch of water, discharged 17.7 cubic feet of gas, specific gravity 560, in the same time.

Now, comparing these discharges by the square roots of their respective impelling columns, we have

Water, Gas,
$$\surd 10 \text{ feet} : 4.96 :: \surd 122 \text{ feet} : 17.33,$$

instead of, as above, the actual discharge 17.70.

Again, Bossut reports, that a hole 2 inches in diameter, with a pressure of 11 feet 8 inches and ten lines of water ,discharged 13.021 cubic inches of water in 21 seconds, or at the rate of 25.52 cubic feet per minute.

It was also found at Leith, that a hole 2 inches in diameter, with a pressure of one inch of water, discharged 69.5 cubic feet of gas, specific gravity .560, per minute.

Reducing the fractions of Bossut's pressure to decimals of a foot, and resolving the pressure into columns of the respective substances we have the proportionate discharge due to these columns:—

Water, Gas,
$$\text{as } \surd 11.736 \text{ feet} : 22.152 :: \surd 122 : 69.41$$

* For Hydrodynamie, read Hydrodynamique.

cubic feet, which may be reckoned to be identical with the result brought out by experiment.

The Abbé Bossut found by experiment, conducted with great care, that a pipe, 2 inches in diameter, 150 feet long, with the pressure of a column of water 2 feet in height, discharged 5.232 cubic inches, or 3.0278 cubic feet of water per minute.

I have been favored by the results of two experiments made with pipes of 2 inches in diameter, and 150 feet long, which, with a pressure of one vertical inch of water, discharged 22.66 cubic feet of gas, sp. gr. .560, and with 2 inches of water 35.16 cubic feet.

In contrasting these experiments, it is to be remarked that the pipes are of the same diameter and of the same length, consequently, the only correction necessary is that due to the variation in the height of their respective impelling columns. Thus, as before, the experiment with one inch of water—

Water, Gas,
as $\surd$ 2 feet : 3.0278 : so is $\surd$ 122 feet : 23.647,

the actual discharge with one inch being 22.66; and that of 2 inches of water—

Water, Gas,
as $\surd$ 2 : 3.0278, so is $\surd$ 244 feet to 33.443

cubic feet—the actual discharge as above having been 35.16.

In 1819, M. Gerard made various experiments with gas apparatus constructed for lighting the Hospital of St. Louis, at Paris, to ascertain the discharges of gas and air through pipes at the distances of 402½, 1233, and 2043 feet respectively from the gasometer,—the discharges of air with a pressure of 0.858 of an inch of water were 30.205, 18.150, and 13.237 cubic feet per minute.

Not having any direct experiments with water made under precisely the same conditions, I shall only apply the hydraulic formula of Debaut, to show the similarity of discharges of that fluid under the same circumstances.

0.858 of an inch of water is equal to 58.334 feet of air—with this head the discharge of water by the same pipe, about the distances above stated, would be 36.206, 21.598, and 14.015 cubic feet.

The close approximation of these results will, I hope, be a sufficient warrant to me for having brought forward the subject with a view to provoke further inquiry; whether the calculation I have entered on, or the deductions drawn from them, be correct or not.

I shall now proceed to compare the rates of compression under this theory, with those indicated by experiment.

Air is found to be compressed into one half its bulk by the addition of a weight equal to that of the atmosphere, or the addition of a force equal to 28330 feet of air. In the same proportions between gas and water indicated by the impelling and retarding forces in a long train of pipes, water should also be compressed into one-half its bulk, by the addition of a force equivalent to a column of itself, 28330 feet or 5.36 miles.

Professor Leslie estimates that it will be only compressed to this degree at the depth of 93 miles.

It has already been mentioned that Mr. Canton had indications which represented the contraction of pure water at 46 million parts, and sea water as 40 million parts, by the addition of a force equal to the weight of the atmosphere. By the rule of compression followed in this paper, pure water would compress 11.65 parts, and sea water 11.55 parts in a million, with the pressure due to an atmosphere of air.

Zimmerman arrived at the conclusion that sea water compresses $\frac{1}{1\,2\,0}$ part, when under the pressure of 1000 feet of its own body.—The present theory indicates that it would contract very nearly $\frac{1\,2}{3\,4\,0}$ parts under the same pressure.

Professor Œrsted's apparatus, judging from the engraving in the Transactions of the British Association, seems to have been incapable of measuring with accuracy the forces stated to have been used.

In 1826, Mr. Perkins laid before the Royal Society a table of compression of water, derived from experiment, in which he states that of a column of 190 inches of water to have been for

		Parts.
10	atmospheres	0.176
100	do.	1.385
200	do.	2.395
500	do.	5.010
700	do.	6.961
1000	do.	8.855

while by the theory now advanced these compressions would have been

		Parts.
10	atmospheres	2.1
100	do.	20.0
200	do.	36.2
500	do.	70.4
700	do.	89.1
1000	do.	102.7

I cannot avoid alluding to a slight though rude corroboration of the theory now advanced—the belief of seamen in the greater density of water at great depths than is generally admitted. They find a great difficulty in sounding in deep water, except with very heavy leads. From the increased weight of the leads required, and from the diminished effect on the hand when sounding, seamen are almost universally impressed with the idea that the loss of effect is produced by the increased density of the water.

I shall only add, that if water be compressible to the degree I have now advanced, and the substances now stated were incompressible, bricks will float at a depth of 28,330 feet; granite at 56,600 feet, or 10 miles; and cast iron at 200,000 feet or 39 miles.

Glasgow Prac. Mech. and Eng. Mag.

Description of a simple method of Magnetizing Steel Bars. By P. Elias, of Haarlem.

At the present day, when the possession of powerful steel magnets must be desirable to experimentalists, it will perhaps not be without interest to many to become acquainted with the method by which the smallest needle, as well as the heaviest steel bar, can be instantly magnetized to saturation with the greatest facility.

The method hitherto employed is that of the double passing, discovered by Knight, and improved by Duhamel and Mitchell. Several persons have proposed the employment of electro-magnets for this purpose, others suspending the steel bar to be magnetized at a red heat to the pole of an electro-magnet, and allowing it to cool in that position. The first method is inconvenient, as it is not possible to move electro-magnets about so freely as steel magnets; the latter, as every one knows, is without effect, consequently, the old method has been retained. This, however, has the inconvenience, that in the first place, it is necessary to be well acquainted with the manipulation of magnetizing; and secondly, that you must already possess that which is to be made, viz., highly powerful magnets, which is rarely the case.

With my method I require nothing more than what every experimentalist possesses, and may be had every where, a powerful voltaic pair, and some copper wire. From twenty-two to twenty-five feet of well isolated copper wire are wound round to form a hollow, very short, but very thick, cylinder. A strong current is passed through the wire, and the steel bar to be magnetized is placed in the cylinder, in which it is moved up and down to the very ends. When the central portion of the steel bar again occupies the cylinder, the circuit is opened, and the bar, which is now perfectly magnetized, withdrawn. When the bar is curved in the form of a horse-shoe, it is well to close it with its keeper during the magnetizing, and when a straight one, to provide it at top and bottom with a piece of soft iron. The wire which I employ is one-eighth of an inch in thickness. The thickness of the wire is not at all indifferent; the same effect it is true may be produced with a thinner one, but then it requires a battery of greater intensity. The voltaic apparatus which I make use of is a single platinum and zinc pair arranged on Grove's principle; it has one-third square foot active platinum surface; the resistance which the current meets with in this battery is equal to that of a clean copper wire, one millimetre in diameter, and two-thirds of a metre in length.* The experiments, however, succeed perfectly well, even when the battery presents a twice or three times greater resistance. My hollow cylinder is one inch high, the bore is nearly one and a half inch in diameter, and its sides likewise one and a half inch thick.

To test the efficiency of my magnetizing cylinder, a friend of mine

* Since in Grove's battery the smallness of the resistance depends not merely on the size of the metallic surface, but likewise considerably on the goodness of the porous earthen cell, which cannot be determined, I have conceived it to be possible to indicate the power of the battery independent of the resistance only in this manner.

had a steel horse-shoe made, weighing thirty-four pounds, of one piece. It was magnetized to saturation by one single passage through a cylinder constructed purposely for this experiment; and a second magnet, after having been placed reversed in the cylinder, proved sufficient to change the poles without having lost its suspending power. Besides the facility and rapidity of this method, it has moreover the advantage, that a bar magnetized in this manner cannot possibly have intermediate poles; and if it previously had possessed any they disappear instantly in the magnetizing cylinder.

This mode is nothing more than the double passing of Duhamel, or Mitchell, only by means of galvanism, and far more powerful, easy, and certain. As in the double passing the opposite poles of the magnet employed must be kept close together, so as to exert successively their greatest action upon each small part of the bar to be magnetized, in like manner I make my cylinder quite short, that each portion of the bar may experience the entire force of the voltaic element.

My friend Dr. Munnich publicly repeated my experiments with the magnetizing cylinder at a meeting of the Utrecht Society of Naturalists, and the Faculty of the Physical Sciences, which was present, was convinced of the efficiency of the method. On this occasion he increased considerably the intensity of some very powerful bars belonging to the collection, which had been magnetized by Knight himself, and reversed their poles by a single passage, &c.

Lond. Edin. and Dub. Philos. Mag.

Acetate of Iron as a remedy for Arsenical Preparations.

The hydrated peroxide of iron is of admitted efficacy in cases of poisoning with uncombined arsenious, or arsenic acid; but according to the experiments of Duflos, it is quite ineffectual when these acids are combined with bases, as, for example, Fowler's solution, or arsenite of potash, or arseniate of potash, which last is frequently employed in calico printing, and is, consequently, easily procured.

In the uncertainty in which the practitioner may be placed as to whether the arsenical poison be free, or combined, it is very important to administer the oxide of iron in such a form as to produce a favorable result; to this end it is convenient to employ the peracetate of iron.

This compound may be prepared by adding to the hydrated peroxide of iron obtained from the decomposition of four parts of liquid perchloride of iron, three parts of acetic acid of density 1.06, and sufficient water to make up 16 parts.

This liquid, which is a solution of peracetate of iron with excess of base, precipitates arsenious and arsenic acid from all their solutions, either free, or combined with any base; 500 grains of it are sufficient to decompose 1880 grains of Fowler's solution.

This result demonstrates that liquid peracetate of iron merits preference in cases of poisoning by arsenical compounds. It should be remembered that its power is more rapid in proportion as it is more

diluted with water; besides which, large dilution prevents all irritating action of the acetic acid set free.—*Journ. de Ch. Méd.*, Novembre, 1844.

[The mode of preparing the above compound is not very clearly stated, for the strength of the liquid perchloride of iron is not given. It may be presumed that peracetate of iron mixed with peroxide is to be employed; the degree of excess of the latter is of little consequence, and the strength of the peracetate is limited by the employment of four parts of acetic acid of 1.06 made up to 16 parts with water, and this, it appears, is to be largely diluted before exhibited.—EDITOR.] Ibid.

Color in Carpets.

SIR DAVID BREWSTER stated that he and Professor Wheatstone had brought to York separate communications on this experiment, with specimens of the rug-work in which it is best exhibited. Having seen Prof. Wheatstone's specimens, he had been induced to limit his communications to a few observations on Prof. Wheatstone's paper, When Sir D. Brewster came to York, he was not aware of the phenomena taking place with any other color but *red* and *green*. Prof. Wheatstone had, however, shown him that *red* and *blue* answered equally well; and he had received letters from two ladies in Scotland, who had not only found that *red* and *blue* exhibited the phenomena, but had both given the probable explanation of their doing so, by ascribing it to the *blue* becoming *green* in the *yellow* light of the candle.

In order to give an explanation of what has been called by some the *fluttering hearts*, from one of the colors having the shape of hearts, Sir D. Brewster mentioned an experiment for the purpose of showing, that any fixed oblect will appear to move on the ground upon which it is fixed, when the light which illuminates it is constantly changing its position and intensity. This experiment consists in moving a candle rapidly in all directions, in front of a statue. The varying lights and shadows produce varying expressions, which give the appearance of life and motion in the features of the statue. Now, in the case of the vibrating hearts, the mixture of the *red* and *green*, whether seen as direct or as accidental impressions, produces successions of light and shadow which give the appearance of motion to the figure upon the *red* or *green* ground. This effect is greatly increased by that remarkable property of oblique vision, in which the retina increases in sensibility as the point impressed is removed from the *foramen centrale*. Hence when we look fixedly at one of the vibrating hearts, it nearly ceases to vibrate, while the others, which are seen obliquely, vibrate with greater distinctness. The phenomenon has been stated to be invisible in daylight; but Sir D. Brewster mentioned that he had, that morning, found that it took place in daylight, provided the colored surface was illuminated from a small hole in the shutter of a dark room. The experiment, indeed, he found to

fail even in candle light, if the illumination proceeded from a great number of lights, or from a mass of light producing a *quaquaversus* illumination like that of the sky. He referred also to the effects produced by colored glasses, and mentioned some facts regarding the unequal absorption of the two colors, which, in drawing conclusions from such experiments, required to be attended to.

Lond. Athenæum.

Elasticity of Rigid Bodies.

Mr. E. Hodgkinson gave an account of some further experiments 'On the defect of Elasticity of Rigid Bodies.' These experiments originated in the suggestion that possibly some of the results which Mr. Hodgkinson had communicated at Cork *(see Athen.* No. 827,) had originated in the friction caused by the supports of the extremities of the bars on which the experiments were performed. He had therefore, in these latter experiments, placed strong friction wheels as supports for the ends of the bars; he had also changed the mode of measuring the deflection. He had previously used a wedge graduated on the side; he substituted for this a fine screw with a divided micrometer head, by which he could measure the 10,000th part of an inch of a deflection. He then gave the numerical details of the sets taken by various bars after they have been loaded and then relieved. The most striking general results were, that the index of the power of the load to which he found the set taken most nearly proportional was 2; that every load, however trivial, caused a set, and that this set did not entirely disappear when the bar was given time to recover its state, but in general diminished greatly.

Dr. Scoresby inquired if Mr. Hodgkinson had tried whether a vibratory motion excited among the particles of the bar would enable them to recover their original arrangement.—Mr. Hodgkinson had not, but promised to attend to the hint.—Dr. Robinson suggested that the vibratory motions should not be excited with violence sufficient to cause mechanical derangement of the particles.—Lord Rosse stated two facts bearing on Mr. Hodgkinson's investigations; one, that the standards which had been made to replace those destroyed by the burning of the House of Commons had been found to alter very slightly but decidedly their dimensions, after having been finished with the greatest care. The other, that cannon were never permitted to be discharged more than 400 times under ordinary circumstances, for after that they were deemed unsafe.—Dr. Robinson stated that a fact which had always appeared very strange to him received a probable explanation from what he had just heard. It was found that the platina standard of a metre which had been constructed under the superintendence of the Academy, and which was a square prism, each of whose four faces, therefore, was entitled to be considered as the standard metre of France, when examined many years afterwards, had no two of its sides of exactly the same length: this was supposed to have arisen from the carelessness of the artist employed in its con-

struction, who had accordingly been much censured. He now deemed it highly probable that it had been originally constructed perfect, but had altered its own form. He also mentioned a case in which the glasses of a telescope having been confined by adjusting screws to their places, to which it was necessary for the perfection of the instrument that they should be brought with extraordinary precision, the images of the fixed stars were found to form a cross of light; and it having occurred to him that the confining screws might, by altering the relative positions of the particles, affect their optical action on the light, it was found upon loosening them, that the irregular image disappeared. Ibid.

On the Liquefaction and Solidification of Bodies generally existing as Gases. By MICHEAL FARADAY, Esq., F. R. S., D. C. L., &c.

The method employed by the author for examining the capability of gases to assume the liquid or solid form, consisted in combining the condensing powers of mechanical compression with that of very considerable depressions of temperature. The first object was obtained by the successive action of two air-pumps; the first having a piston of one inch in diameter, by which the gas to be condensed was forced into the cylinder of the second pump, the diameter of whose piston was only half an inch. The tubes into which the air, thus further condensed, was made to pass, were of green bottle glass, from one-sixth to one-quarter of an inch in external diameter, and had a curvature at one portion of their length adapted to immersion in a cooling mixture: they were provided with suitable stop-cocks, screws, connecting pieces, and terminal caps, all very carefully made, and rendered sufficiently air-tight to retain their gaseous contents under the circumstances of the experiments, and when they were sustaining a pressure of fifty atmospheres, as ascertained by mercurial gauges connected with the apparatus. Cold was applied to the curved portions of the tube by their immersion in a bath of Thilorier's mixture of solid carbonic acid and ether. The degree of cold thus produced, when the mixture was surrounded by the air, estimated by an alcohol thermometer, was a temperature of —106° Fahr. But on placing the mixture under an air-pump, and removing the atmospheric pressure, leaving only that of the vapor of carbonic acid, which amounted only to 1-24th of the former, (that is to the pressure of a column of 1.2 inch of mercury,) the thermometer indicated a temperature of 166° below zero of Fahrenheit's scale. In this state, the ether was very fluid; and the bath could be kept in good order for a quarter of an hour at a time.

The author found that there were many gases which, on being subjected to cold of this extreme intensity, condensed into liquids, even without a greater condensation than that arising from the ordinary atmospheric pressure, and that they could then be preserved, sealed up in glass tubes, in this liquid state. Such was the case with chlorine,

cyanogen, ammonia, sulphuretted hydrogen, arseniuretted hydrogen, hydroiodic acid, hydrobromic acid, carbonic acid, and euchlorine.

With respect to some other gases, such as nitric oxide, fluosilicon, and olefiant gas, it was difficult to retain them for any length of time in the tubes, in consequence of the chemical action they exerted on the cements used in the joinings of caps and other parts of the apparatus. Hydroiodic and hydrobromic acids could be obtained either in the solid or liquid state. Muriatic acid gas did not freeze at the lowest temperature to which it could be subjected. Sulphurous acid froze into transparent and colorless crystals, of greater specific gravity than the liquid out of which they were formed. Sulphuretted hydrogen solidified in masses of confused crystals of a white color, at a temperature of —122° Fahr. Euchlorine was easily converted from the gaseous state into a solid crystaline body, which, by a slight increase of temperature, melted into an orange-red fluid. Nitrous oxide was obtained solid at the temperature of the carbonic acid bath in *vacuo*, and then appeared as a beautifully clear and colorless crystaline body. The author conceives that in this state it might, in certain cases, be substituted with advantage for carbonic acid in frigorific processes, for arriving at degrees of cold far below those hitherto attained by the employment of the latter substance. Ammonia was obtained in the state of solid white crystals, and retained this form at a temperature of —103°.

The following liquids could not be made to freeze at —166°; namely, chlorine, ether, alcohol, sulphuret of carbon, caoutchoucine, camphine, and rectified oil of turpentine.

The following gases showed no signs of liquefaction when cooled by the carbonic acid bath, even when subjected to great pressure; namely,

Hydrogen, Oxygen, at a pressure of	27	atmospheres.
Nitrogen and nitric oxide at a pressure of	50	do.
Carbonic oxide at a pressure of	40	do.
Coal gas at a pressure of	32	do.

Proc. Royal Soc.

On some of the Substances which reduce Oxide of Silver and precipitate it on Glass in the form of a Metallic Mirror. *By* JOHN STENHOUSE, *Ph. D.*

It has long been known that aldehyde, when heated in a tube with ammonio-nitrate of silver, reduces the oxide to the metallic state, and forms a brilliant coating on the inner surface of the tube. Three other substances, saccharic acid, salicylic acid and pyromeconic acid were also known to possess the same property, though the coatings which they yield are much darker, and therefore less beautiful than those formed by aldehyde. This was the state of our knowledge previous to the announcement, about six months ago, of Mr. Drayton's process for silvering mirrors in the cold, by means of ammonio-nitrate of silver and an alcoholic solution of the oils of cloves and cassia.

I find that the number of substances which, especially when assisted by heat, give more or less brilliant coatings of reduced silver, is much greater than has hitherto been supposed. Thus grape-sugar forms a pretty brilliant mirror even in the cold. When unassisted by heat the mirror is rather slowly formed, requiring from six to twelve hours; but when a slight heat is applied it forms very readily in the course of a few minutes; the coating is much darker than that produced either by aldehyde or by Drayton's process. Cane-sugar also yields a mirror when assisted by heat, but none in the cold. Gum-arabic and starch also yield dark-colored mirrors, but more slowly, and require considerable boiling: so do phloridzine and salicine. Oils of turpentine and laurel also give mirrors, but with still greater difficulty, the solutions requiring to be very concentrated. Resin of guaiacum acts in a similar manner.

Oil of pimento, as is well known, consists of two oils, one an acid oil, which is heavier than water, and forms crystaline compounds with the bases; this in the course of a few minutes, even in the cold, produces as brilliant a coating of silver as the mixture of the oils of cassia and cloves. The neutral portion of the pimento oil, which is lighter than water, does not reduce nitrate of silver even after long boiling. I could not succeed in forming metallic mirrors with cinnamic, benzoic, meconic, komenic, tannic or pyrogallic acids, with gum benzoin, elemi or olibanum, with oil of rhodium or with glycerine.

Ingenious as Mr. Drayton's patent process certainly is, it labours under a very serious inconvenience, which I greatly fear will not be easily remedied. In the course of a few weeks the surface of the mirrors formed by his process become dotted over with small brownish-red spots, which greatly injure their appearance. The cause of the spots seems to be this—that the metallic silver while being deposited on the surface of the glass carries down with it mechanically small quantities of a resinous matter, resulting, most probably, from the oxidation of the oil. This resinous matter which is interposed between the glass and the silver, in the course of time begins to act on the metallic surface with which it is in contact, and to produce the small brown spots already mentioned. If an excess of the essential oils is employed to precipitate the silver, the metallic mirror is much darker, and gets sooner discolored than usual. No doubt the alcohol present in the solution keeps up much of the resinous matter; still a little of it is almost always deposited on the silvered surface, and acts in the injurious way described. Proc. Chem. Soc.

On the Electricity Developed in the Manufacture of Machine-made paper. *By* Dr. HANKEL.

From Poggendorff's Annales, as translated in Mr. Walker's "Electrical Magazine," for January, 1845.

That paper, when warmed, and afterwards rubbed on a table with a brush, or with Indian-rubber, presents very marked electric indications, is an experiment which is undoubtedly very well known.—

However, I think that the following short notice of the appearance of very powerful negative electricity, during the manufacture of machine-paper, will be interesting. This phenomenon was mentioned to me by M. Keferstein, a paper-maker at Krollwitz, near Halle; and I have myself had the opportunity of observing the same. When the paper has left the rocking-table, and the water has partly run through the wire-frame that passes, on an endless band, over a couple of rollers, and is then pressed out by a roller placed near the wire-frame; the paper thus made still remains damp, although it possesses some degree of solidity; it thence passes over to the rollers, which are heated by steam, and is accompanied among the first three by a hair-cloth, but goes over the fourth without the aid of a hair-cloth; after it has gone between the last pressing rollers, the very wide paper sheet is cut into three narrow stripes, of the width of an ordinary sheet of paper, by sharp circular cutters placed in a roller, and it is then rolled upon a cylinder. So long as the paper is accompanied by the hair-cloth, no signs of electricity are manifested; they appear when it leaves the last steam-roller, or rather, the last pressing-roller.

It appears by experiment that the heat of the last steam-roller exercises great influence, inasmuch as the electrical phenomena are much stronger the more the heat of the last steam-roller is increased; they are frequently so strong that very loud sparks dart from the paper to the last smoothing-roller (a small guiding-roller of copper,) and to the roller on which the cutters are fixed. If the finger is brought near to the paper, a rapid succession of small sparks are perceived to pass from it to the paper. A Leyden jar can easily be charged. The electricity remains in the paper for a considerable time.

When only a few coils of paper are on the cylinder, the electricity is feeble; but it increases considerably with the number of folds. If the paper is cut away from the cylinder, and the long strips are thrown asunder, many strong and very brilliant sparks fly between them. This electricity is evidently produced merely by the heating of the paper, and its being pressed by means of the rollers. No friction can take place, because the velocity of the circumference of all the rollers is exactly the same. The evaporation of water is certainly no cause of the electricity appearing at the end of the machine; since, just in those parts where the evaporation is the strongest, no signs of electricity are manifested; and the damp paper, being a conductor, conveys all that is so produced to the metal rollers.

Note.—Compare *Gib. Ann.*, vol. lxxv. p. 197.—I take the liberty of observing, that the appearance of electricity in the fabrication of paper is no new phenomenon: probably there are few proprietors of such manufactories who have not noticed it, as it is even a hindrance in folding the paper. In the meanwhile, this phenomenon has not been mentioned in the *Annalen;* nor, so far as I can discover, has it been noticed in works on natural philosophy; on which account the circumstance may be unknown to many readers of this journal.

A similar production of electricity has for many years been noticed in Mr. Mackintosh's manufactory at Glasgow, on tearing asunder the well known water-proof cloth, which is stuck together by means

of a solution of Indian-rubber in coal-tar.*—(*Edin. Phil. Jour.* vol. x., p. 185.) Lately, also, they have been seen by Mr. Marsh, at Woolwich, on grinding newly roasted coffee in an iron coffee-mill; they passed between the mill and a tin can placed one-tenth of an inch distant.—(*Ann. of Elect.* vol. viii. p. 124.) Lastly, a very strong attraction has been noticed in a cotton-mill, in a broad endless band, that passes horizontally over two cylinders of almost 3 feet in diameter, which revolves seventy-two times in a minute.—Cotton-wool was attracted from a distance of two or three feet; and, four feet beneath the band, the hair of the workman stood on end.—(*Ann. of Elect.* vol. v., p. 397.)—*Editor of the Annalen.* Mechanics' Mag.

On a new Bleaching Principle produced by the slow combustion of Ether in Atmospheric Air, and by the rapid combustion of Bodies in a jet of Hydrogen Gas. By Prof. Shoenbien.

Prof. Shoenbein observing that a peculiar principle, in many respects similar to chlorine, was developed during a slow combustion of phosphorus in the atmosphere, was led to inquire into the product of the slow combustion of the vapor of ether mixed with atmospheric air. He finds that, besides well-known compounds, such as formic and acetic acids, there is evolved a principle hitherto unnoticed, which possesses oxidizing and bleaching properties in an eminent degree.—It decomposes indigo, iodide of potassium, and hydroiodic acid, and also, though more slowly, bromide of potassium. When in contact with water, it converted iodine into iodic acid, and sulphurous into sulphuric acid; changes the yellow ferro-cyanide of potassium into the red, and the white cyanide of iron into the blue; it transforms the salts of prot-oxide of iron into those of the peroxide, and it discharges the colors produced by sulphuret of lead. The author points out the similarity between the action of this substance, in these instances, and that of chlorine and ozone. Analogous results were obtained from the combustion of a jet of hydrogen gas in atmospheric air, and even, under particular circumstances, from the flame of a common candle, and also from various other inflammable bodies when burning under certain conditions. The author is hence led to the conclusion that this peculiar oxidizing and bleaching principle is produced in all cases of rapid combustion taking place in atmospheric air, and that its production is therefore independent of the nature of the substance which is burnt. Proc. Royal Soc.

On the Artificial Formation of a Vegeto-Alkali. By George Fownes, Esq.

The substance which is the subject of investigation in this paper is a volatile oil, obtained by distillation from a mixture of bran, sulphuric acid, and water, and is designated by the author by the name of

* We may mention that the two cloths are passed between two steam-rollers highly heated; and that the adhesive solution is between the cloths as they enter the rollers.—Ed. Elec. Mag.

Furfurol. Its chemical composition is expressed by the formula, $C_{15}\ H_6\ O_6$, and its properties are the following:—When free from water and freshly rectified it is nearly colorless; but after a few hours, it acquires a brownish tint, which eventually deepens almost to blackness. When in contact with water, or when not properly rendered anhydrous, it is less subject to change, and merely assumes a yellow color. Its odour resembles that of a mixture of bitter almond oil and oil of cassia, but has less fragrance. Its specific gravity at 60° Fahr. is 1.168. It boils at 323° Fahr., and distils, at that temperature, without alteration. It dissolves to a large extent in cold water, and also in alcohol. Its solution in concentrated sulphuric acid has a magnifient purple color, and is decomposed by water. Nitric acid, with the aid of heat, attacks the oil with prodigious violence, evolving copious red fumes, and generating oxalic acid, which appears to be the only product. It dissolves in a solution of caustic potass, forming a deep brown liquid, from which acids precipitate a resinous matter.—With a slight heat, it explodes when acted upon by metallic potassium. When placed in contact with five or six times its bulk of liquid ammonia, it is gradually converted into a solid yellowish white and somewhat crystaline mass, which is very bulky, perfectly soluble in cold water, and easily obtained in a state of dryness under a vacuum. The formula expressing the chemical constitution of this substance, or of *furfuroamide*, is $C_{15}\ H_6\ N\ O_3$, and it is classed by the author with the *amides*. The oil itself appears to be identical with the substance described by Dr Stenhouse, under the name of artificial oil of ants. Another substance, isomeric with the *amides*, and of which the formula is $C_{30}\ H_{12}\ N_2\ O_6$, was obtained by the author, and termed by him *furfurine*, and found to have the properties of a vegeto-alkali and to form saline compounds with various acids. Proc. Royal Soc.

TRANSLATIONS FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Absorption of the Rays of Heat by the Terrestrial Atmosphere.—Extract of a letter from M. Melloni *to* M. Arago.

The only pages of my memoir, which may probably excite interest, are those in which are reported, for the first time, the results deduced from a long series of observations on Solar heat. In numerous repetitions, by means of the same prism of rock salt, of the analysis of these rays, I have proved that the *maximum* of temperature is not always in the same place in the dark space which is prolonged beyond the red limits of the spectrum, but sometimes more and sometimes less distant from the colored portion, and that under circumstances perfectly similar with regard to radiating force, to the serenity of the sky and the transmission of the air. I conclude from this, that the calorific rays deprived of light, reach us in quantities greater or less according to the condition of certain atmospheric constitutions which exert no influence on the transmission of luminous rays. Now, it appears to me that there is a striking analogy between this phenomenon and that observed by M. Daguerre, relative to the direct action of the chemical

radiations corresponding to equal heights of the sun above the horizon. In the latter case, it would be the dark part of that radiation, situated beyond the limit of the violet, which would undergo, on its way, a greater or less absorption, in virtue of a certain modification, which might not alter the transparency of the atmosphere. It is true that, on this hypothesis, we must admit that the permeability of the air for the dark chemical rays, may be different in certain cases from its permeability for luminous rays. But are we not in possession of very many facts which prove that this is actually the case with regard to optical, calorific, phosphogenic and chemical effects produced by the same radiation?

Ann. de Chem., Nov. 1839.

On the force of tension of some condensed gases. By M. Bunsen.

I first measured the resistance of the glass tubes which I intended to use. I filled them completely with water (after introducing a small manometre) and then plunged them into water, which I gradually heated to the boiling temperature—which, by the expansion of the water within the tubes, represented a pressure of 150 atmospheres. When the tubes burst under this pressure there were generally an infinite number of longitudinal parallel fissures and accompanied by a piercing noise.

A tube of $11\frac{1}{2}$ millimetres in internal diameter and $1\frac{1}{2}$ mill. in thickness, burst under a pressure of 80 atmospheres, and I found tubes of a smaller diameter which resisted 200 atmospheres. But after a while their tenacity became so diminished that some of them which had supported 30 atmospheres, suddenly broke under a pressure of scarcely 4 atmospheres. I attribute this to a diminished elasticity in the glass, like that of all other bodies, in proportion to the length of time in which they have been subjected to great pressure.

I have submitted cyanogen, sulphurous acid, and liquid ammonia to different temperatures, in glass tubes containing a manometre, and the result was the following tensions, calculated in metres of mercury.

Temperatures.	Sulphurous Acid.	Cyanogen.	Ammonia.
— 33.7			.749
— 30.0			
— 25.0			
— 20.0		.80	
— 15.0		1.10	
— 10.0	.78	1.41	
— 5.0	1.11	1.73	3.64
0.	1.48	2.07	3.61
+ 5.0	1.91	2.44	4.26
+ 10.0	2.89	2.88	4.98
+ 15.0	2.93	3.33	5.78
+ 20.0	3.54	3.80	6.67
+ 25.0	4.20		

Sulphurous acid boils at —10° 5 under a barometric pressure of 0.744 metres.

Cyanogen becomes liquid at —25°c, and begins to solidify at —30°, assuming a radiated texture. Its boiling point is —20.7c.

Ammoniacal gas must be perfectly dried before being liquified. Its boiling point is —33°.7.

I have in vain tried to reduce to the liquid state, by a reduction of temperature as far as —50°, the gas which results from the combination of hydrogen with chlorine, brosmine, iodine and phosphorus.

We may obtain sulphuretted hydrogen in a liquid state by subjecting hypersulphuretted hydrogen to decomposition in a tube; but it requires the presence of a little water. If bits of chloride of calcium be introduced into the tube, the hypersulphuret may be preserved intact while the tube remains hermetically sealed.

Annales des Mines, tom. xvii, p. 317.

Chemical constituents of Sugar Beet. By HENRY BRACONNOT.

It results from the researches that I have made on the Sugar Beet of Silesia, that this root contains—1, crystalizable sugar; 2, non crystalizable sugar; 3, albumine; 4, pectine; 5, mucilaginous matter; 6, liqueous matter; 7, phosphate of Magnesia; 8, oxalate of potash; 9, niclate of potash; 10, phosphate of lime; 11, oxalate of lime; 12, an acid fat having the constitution of tallow; 13, matter analogous to wax; 14, chloride of potassium; 15, sulphate of potash; 16, nitrate of potash; 17, oxide of iron; 18, animalized matter soluble in water; 19, an unknown odorous and acrid matter; 20, indeterminate sal ammoniac in small quantity; 21, pectic acid. Ann. de Chem. Dec., 1839.

Manufacture of Leaden Bullets, by rolling.

At the Arsenal, at Woolwich, in England, they now manufacture leaden bullets by drawing and compression.

These bullets have the advantage of being without *blows* or air cavities, and are rolled out of round bars of lead, which are passed between rolls formed like the roulettes used for ornamental work on the lathe.

The rolls are constructed with hemispherical cavities, each one of which forms one half of the ball, whilst the correspondent cavity forms the other half; the bullets are then finished by removing the extra metal, and being rolled together in a barrel. Journal des Usines.

On the Irregular Movements of the Barometer. By T. HOPKINS.

Mr. Hopkins maintained that the *irregular* movements of the barometer arise, not from the alterations of surface temperature, but from the condensation of aqueous vapour, and the consequent formations of rain. This (he said) caused local heatings of the atmosphere and considerable reductions of its pressure in the locality, particularly in the colder latitudes. Within the tropics, the barometer does not ordinarily fall as much as in colder latitudes, notwithstanding the abundant rains which take place there, because the conden-

sation occurs, and the temperature is increased at a greater height in the atmosphere, and the reduction of the incumbent pressure in the part is spread over a wider area. The condensation takes place too at an elevation, where the air, from being subjected to inferior pressure, is more attenuated, and the heating is consequently more diffused. Rain is formed in certain latitudes, say at an average height of 3,000 feet, where the air has a density proportioned to that height, and where the whole effects of the local heating are confined to an area of moderate extent, thus reducing the pressure of the atmosphere on the barometer in every part of that area in a considerable degree; whilst, in other parts nearer the equator, the condensation which produces rain takes place at an average height of, say 6,000 or 9,000 feet, where the air is rare in proportion to the height; the heating effects are, therefore, diffused to a corresponding extent, whilst the reduction of pressure at the surface is spread over a wider area. It follows, that with equal amounts of rain, the fall of the barometer will be the greatest and confined to the smallest area, in the coldest climates. Mr. Hopkins also represented that the *diurnal* oscillations of the barometer arise from, first, the condensation of aqueous vapor into cloud, and then from the evaporation of the particles of water that constitute that cloud. He stated, that the morning sun warmed the lower air, and caused it to rise until condensation formed cloud, and liberated heat sufficient to warm a mass of the atmosphere, and thus to cause the barometer in the locality to begin to fall at, say about ten o'clock in the morning, which fall continued until about four o'clock in the afternoon, when condensation ceased. From this time, evaporation of the cloud commenced which cooled the air in part —made it heavier—and caused the barometer to rise until about ten o'clock, P. M., by which time the cloud was evaporated. The cooled and heavier air now descended to the surface, from which it absorbed a portion of heat, and became somewhat warmer. From this second warming of the air, and from a reduction of the quantity of aqueous vapor in the atmosphere, as is evidenced by the fall of the dew point, the barometer again fell, and from the operation of these two causes, continued to fall until four in the morning; from which time, those general cooling influences that operate in the absence of the sun, caused the barometer again to rise till ten in the morning, thus completing the two risings and two fallings in the twenty-four hours.—This was shown to be in general accordance with the tables of the Plymouth observations for three years, and with those made at Madras and Poona. The fact, also found in the Plymouth observations, that the dew point rose with the temperature until eleven o'clock, A. M., when, although the temperature continued rising, the dew-point did not rise higher, showed that the vapor formed during the hottest part of the day was expended in supplying that which was condensed in forming the daily cloud. According to these tables, also, the dew point at the surface continued stationary until four o'clock, P. M., when it began to fall, and continued falling with the declining temperature until the great cold resulting from evaporation ceased. The diurnal fluctuations were also shown to be the least, when the irregu-

lar were the greatest (as observed by Mr. Birt,) because rain was then produced, and evaporation prevented from cooling the air at the regular diurnal period, and in that way prevented the rise of the barometer at that recurring period. London Athenæum.

Statistics of Hosiery.

Mr. FELKIN read a paper on the statistics of the Hosiery manufactured by machinery in the United Kingdom, compiled from an actual census taken under his direction in the present year. He stated that before the age of Elizabeth, stockings were either knitted of coarse woolen thread or cut out of linen and silken tissue. Towards the close of the sixteenth century the Rev. W. Lee succeeded in producing the stocking-frame, and his ingenuity was appreciated by Queen Elizabeth, who visited him at his lodgings, and accepted specimens of his productions. Her kinsman, Lord Hunsdon, entered into a kind of partnership with Lee, and one of the Tudor family became the first stocking-makers' apprentice. James I. refused to follow the enlightened policy of Elizabeth; and Lee, neglected in England, accepted the offers made by the French minister Sully; he established a manufactory at Rouen, but after the murder of Henry IV. the patronage he had received was withdrawn, and he died of a broken heart. The stocking-frame spread rapidly over England, France, Spain, and the Netherlands; Lee's brother introduced the manufacture into London, where the "Frame-work Knitter's Company" still exists, though it has been long an empty name. Out of 660 frames, in 1669, there were 460 in London, three-fifths of the whole being employed in the manufacture of silk goods. In 1710 there were 100 frames destroyed in London on account of disputes about wages, and in 1714 there were 2,500 frames in London, 600 in Leicester, 400 in Nottingham, and about 8,600 throughout all England. From this time the trade began to leave London, probably from the vexatious nature of the company's regulations; and in 1753, when the total number of frames in England was 14,000, London had fallen to 1,000, while Nottingham had risen to 1,500, and Leicester to 1,000. The application of the stocking-frame to the manufacture of imitations of pillow lace, led the way to a great variety of ingenious inventions, and a consequent extension of the trade: in 1782 there were about 20,000 frames in England, of which 17,350 were in the midland counties.—Though the stocking-makers and lace-makers started from the same point, their fate has been very different; the manufacturers of stockings are about the worst paid and those of lace among the best paid of the operative classes. Mr. Felkin stated that there are about 42,652 persons engaged in the manufacture of stockings, and as many more employed to wind, seam, and sew up the hose. He denied that as a class they were idle and negligent; he had known them from boyhood, having worked for his support at their frames, and he knew that they were no worse than hard work and small wages would make any class of the community. To explain the position of the stocking

manufacturers, Mr. Felkin stated that the frames were rarely the property of the workmen, but belonged either to the hosiers or to a class of middlemen, who let them to the operatives. Foreign competition has had little effect upon this branch of industry, for the amount of the exportation of hosiery has never been important. There were only 147,507 dozens exported in 1843, and that was nearly double the amount of the preceding year. Mr. Felkin then referred to some diagrams exhibited in the Section, to explain the nature of working the frames; the operation is one of considerable toil, but does not for ordinary goods require much skill and training; the employment is injurious to the sight. It is for the most part a domestic branch of industry, and has no connexion with the factory system. The total number of frames in the three midland counties is 39,442 employed and 4,298 unemployed. There are 1,572 frames in the rest of England, 265 in Ireland, and 2,605 in Scotland; and taking the whole of Great Britain there are 42,632 employed and 5,830 unemployed, (many of the latter, however, being under repair,) making a total of 48,482 frames available for the machinery of the trade. The earnings of the frame work knitters are subject to heavy deductions, for the rent of frames and other incidents, which frequently reduce the net earnings to a most miserable sum. The earnings, clear of shop deductions and expenses, range generally from 4*s.* 6*d.* to 7*s.* per week, and in some places, where cotton-hose is chiefly made, wages are even lower than the above minimum. Many cases of hardship from excessive frame rent were recorded; and it deserves to be remarked, that frames are not perishable articles, many of those now in use having been manufactured in the reign of Queen Anne. The general condition of the frame-work knitters is described as very deplorable; they work generally from fourteen to fifteen hours per day, and their net earnings are generally inadequate to procure subsistence for themselves and their families. The ultimate results of the hosiery trade are to turn imported raw materials and those of home-growth of the collective value of 705,900*l.* into the selling value of 2,562,713*l.* There are manufactured annually 84,000 dozen of silk stockings and socks, 2,164,000 cotton, and 1,770,000 of worsted. Including gloves and other hosiery products, the annual production is 5,705,600 dozen, which would not give more than one pair of stockings and one pair of gloves for each inhabitant of Britain. Ibid.

On a Method of Electrotype, by which the Deposition on Minute Objects is easily accomplished. By L. B. Ibbetson.

From the difficulties which arose from the application of plumbago, in the ordinary manner, a portion of the plumbago was united with a solution of phosphorus in oil, and the article to be electrotyped immersed in it. It thus became covered with a coating, on which the metal was deposited in a beautiful and uniform manner. Such specimens of cactuses thus covered with metal were exhibited.

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